# ESTIMATION OF ABUNDANCE AND DISTRIBUTION OF CHINOOK SALMON IN THE YUKON RIVER USING MARK-RECAPTURE AND RADIO TELEMETRY IN 2000 AND 2001


By

Ted R. Spencer

Richard S. Chapell

Toshihide Hamazaki

John H. Eiler


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## AUTHORS

Ted Spencer is a Fishery Biologist for the Alaska Department of Fish and Game, Commercial Fisheries Division, 333 Raspberry Road, Anchorage, AK 99518.

Rich Chapell is a Fishery Biologist for the Alaska Department of Fish and Game, Commercial Fisheries Division, 333 Raspberry Road, Anchorage, AK 99518.

Toshihide Hamazaki is a Biometrician for the Alaska Department of Fish and Game, Commercial Fisheries Division, 333 Raspberry Road, Anchorage, AK 99518.

John Eiler is a Fishery Research Biologist for the National Marine Fisheries Service, Auke Bay Laboratory, 11305 Glacier Highway, Juneau, AK 99801.



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## ABSTRACT

The goal of this multi-year (1999-2002) cooperative study between the Alaska Department of Fish and Game and the National Marine Fisheries Service was to determine the migratory characteristics and escapement distribution of Yukon River chinook salmon. Primary objectives in 2000 and 2001 were to assess and refine fish capture and radio-tracking methods for a full-scale program in 2002, and to estimate drainagewide population size using mark-recapture techniques. Adequate numbers of fish were captured with various types of drift gillnets near the villages of Marshall and Russian Mission, suggesting full-scale tagging programs in subsequent years are feasible. Drift gillnet of 8.5″ mesh size constructed with #21 seine twine was the most effective gear type for capturing chinook salmon in suitable condition for tagging and minimized the catch of other species. Of the 760 fish (in 2000) and 2,313 fish (in 2001) captured, 675 fish (2000) and 2,011 fish (2001) were spaghetti tagged, and 91 fish (2000) and 117 fish (2001) were radio-tagged. Although difficulties were experienced tracking radio-tagged fish in the lower river in 2000, improvements in telemetry equipment effectively resolved this problem in 2001. Chinook salmon responded well to the tagging procedures. Among the radio tagged fish, 70% in 2000 and 97% in 2001 moved upriver. Migration rates averaged 53 km/d (2000) and 52 km/d (2001), which is consistent with untagged fish migration rate estimates. Incomplete coverage of remote tracking stations hindered distribution results but of the radio tagged fish, 28% (2000, 2001) moved to the Tanana River (875 km from the tagging site), 25% (2000) and 28% (2001) moved to Canada (849 km from the tagging site). Of the tagged fish caught in the U.S. fisheries (17%, 2000; 20%, 2001), most (78%, 2000; 61%, 2001) were caught in District 3 and Subdistrict 4a fisheries. Drainagewide estimate of abundance was 112,389 (CV = 0.16) for 2000 and 358,098 (CV = 0.14) for 2001.

KEY WORDS: mark-recapture, radio-tracking, chinook, salmon, Yukon River, Tanana River, drift gillnet

## FOREWORD

The United States Congress appropriated $7.0 million to the State of Alaska, Western Alaska Disaster Grant in 1998 responding to fishery disasters that occurred in Bristol Bay, and in the Kuskokwim and Yukon Rivers. The funding was designated for developing research to mitigate and prevent future fishery disasters. Out of $7.0 million, $1.3 million was designated to the Alaska Department of Fish and Game (ADF&G) for the Yukon River chinook salmon radio telemetry study. This study encompasses three years, the first two years for feasibility, and the following year for field studies. The main objectives of this study were to examine run behaviors, estimate the run proportion among tributaries, and estimate population size of Yukon River chinook salmon.

## INTRODUCTION

### *Yukon River Chinook Salmon*

The Yukon River crosses over 3,000 km of Alaska originating from Yukon Territory in Canada, and covering over 855,000 km$^2$ of interior Alaska and Canada including many tributaries, the largest being the Koyukuk, Tanana, and Porcupine Rivers (Figure 1). Chinook salmon *Oncorhynchus tshawytscha*, spawning in tributaries throughout the U.S. and Canada, are an extremely important species in the state and Canada for commercial, subsistence, and sport fisheries. The Yukon River chinook salmon commercial fishery has been one of the most valuable fisheries in the state and chinook salmon are a main subsistence staple for rural residents. The fishery is managed to maintain adequate spawning escapements, provide harvest opportunities, and provide adequate passage to the Canadian portion of the drainage. Determining run timing, distribution, abundance, and proportion information for each stock is important for fishery managers because most of the fishery occurs in the downstream portion of the river before adequate numbers of chinook salmon reach the upriver spawning grounds.

The run has been assessed in various projects and tributaries, including Anvik River carcass sampling, Gisasa River weir, Henshaw Creek weir, Nenana test-fishery wheel, US-Canada border mark-recapture, Dawson City test-fishery, and Whitehorse fishway study. Additional projects include Nulato River, Chena River, Salcha River, and Chatanika River towers. Those studies estimate runs in each tributary, however the relative contribution of each tributary to the entire run is unknown. Tagging studies were conducted between 1961-1970 to estimate migration rate, to estimate run proportions among tributaries, and to estimate drainagewide population. Early studies (1961-1967) were conducted in the lower Yukon, but the results were unreliable because coverage of the several, lower river channels and lower river commercial catch was inadequate. Later studies were moved upriver to mitigate these problems, but insufficient numbers of tagged chinook salmon resulted in limited information (Geiger 1968, Lebida 1969, Trasky 1973). For drainagewide run timing and abundance estimation, Emmonak test-fishery (JTC 2001) and Pilot Station sonar studies (Pfisterer 2002) were conducted.

### *Radio Telemetry and Mark-Recapture Study*

The U.S. and Canada have agreed to conduct cooperative research to examine migratory patterns and population status of Yukon River chinook salmon. As part of this research, ADF&G and the National Marine Fisheries Service (NMFS) implemented a cooperative radio telemetry and mark-recapture study (Appendix A) to provide information on the migratory characteristics and escapement distribution of chinook salmon, including spawning distribution, run timing, and migration rates of the various stocks, and to estimate drainage wide run abundance. While the proposed study represents severe logistical challenges, similar telemetry work on chum salmon (*O. keta*) in the upper Yukon River basin (JTC 1996, 1998) suggests that a basin-wide telemetry study on chinook salmon is feasible.

The work conducted in 2000 and 2001 focused on addressing logistical considerations for a basin-wide telemetry study in 2002. The primary objectives were to develop appropriate capture methods (e.g., fish captured in suitable condition for tagging) and evaluate the capability of the equipment to track radio-tagged salmon in deep water in the lower basin where depths are often greater than 10 m. Another major objective was to complete the infrastructure necessary to successfully track the movement of radio-tagged fish upriver. For mark-recapture run size estimation, these studies evaluated feasibility of drainagewide abundance estimates using each tributary as a recapture site.

Specific objectives addressed in this study:

Radio telemetry:

1. Evaluate if adequate numbers of fish can be captured to conduct a full-scale radio telemetry program.
2. Determine the capture method most effective for chinook salmon and in a condition suitable for tagging.
3. Evaluate the effects of handling and tagging on the migratory behavior of fish.
4. Determine the feasibility of tracking radio-tagged fish in the lower Yukon River mainstem.
5. Determine the movement patterns and distribution of marked fish within the basin.

Mark-Recapture:

1. Estimate the total annual abundance of chinook salmon with the relative precision coefficient of variation less than 20%.
2. Estimate the age composition of chinook salmon at each capture location.
3. Estimate run timing and migration rate of the various stocks of chinook salmon with estimation precision dependent on observed sample sizes.

## METHODS

### *Chinook Salmon Tagging and Handling*

Chinook salmon were captured and tagged near the villages of Marshall and Russian Mission. A tagging crew consisted of a locally hired contract fisher and three Department personnel in 2000, and two locally hired contract fishers and two Department personnel in 2001. In both years, Department personnel were responsible for the handling and tagging of fish, while the contract fishers were responsible for operating a boat and deploying a net. Fishing started before chinook salmon were present, and ended when catches were either very low in 2000, or when no chinook salmon were caught in an eight hour fishing period in 2001. Tagging was conducted daily during morning and evening periods, each of 8 hours (morning: 0900 – 1700; evening: 1800 – 0200).

Drift gillnets were used to capture fish because of their effectiveness in capturing the target species with minimum injuries. Six types of gillnet were used in 2000, including nets with Momoi MT-50 or MT-73 multi-monofilament fiber, color shade 3, length 37 m (20 fathoms), depth 7.6 m (25 feet), and hanging ratios of 2:1 or 3:1. Based on results from the first year, gillnets used in 2001 were Momoi MT-73 14-strand multi-monofilament fiber, color shade 3, length 46 m, depth 7.6 m, with a hanging ratio of 2:1. Three mesh sizes (6.5″, 7.5″, and 8.5″) were used in 2000, and only 8.5″ mesh size used in 2001. In addition, 8.5" mesh size gillnets constructed with # 21 seine twine (length 46 m, depth 7.6 m, with a hanging ratio of 2:1) and 4″ mesh size gillnet (Momoi MT fiber, color shade 3, length 37 m, depth 7.6 m, hanging ratio 3:1) were used to compare differences in fish injury and catch rates with the standard gillnets used for chinook salmon.

A net was retrieved as soon as a crewmember detected captured chinook salmon. Captured fish were either carefully removed from the gillnet while in the river and brought on board in a dip net, or brought on board with the gillnet and then removed. When the number of captured fish exceeded capacity of the live tank, all remaining fish were released while they were still in the river. The fish were placed in a neoprene-lined tagging cradle (designed by NMFS) while they were tagged, sampled for age through removal of 3 scales from the preferred area (Welander 1940), and measured for length (mid-eye to fork-of-tail [MEF]) to the nearest 5 mm. Gender was determined from visual observation of secondary maturation characteristics. In addition, the presence and type of injuries were recorded. Uninjured fish and some fish with minor injuries were tagged and sampled for age, sex, and length (ASL). Fish with greater injuries were released untagged, and mortally injured fish were retained for subsistence use after ASL sampling.

Each fish was tagged with a uniquely numbered 14″ long external spaghetti tag. The tag was filled with 100 lb monofilament core in 2000 and fine cable (jeweler's line) in 2001. A yellow tag was used for radio-tagged fish, and a light blue tag was used for other fish. White spaghetti tags were used for fish without radio tags in 2001 because of a shortage of blue tags. All tagged fish were given external secondary marks. In Marshall, the left axillary process was removed, and in Russian Mission the right one was removed. The removed axillary process was retained for genetic analysis in 2001. As a tertiary external mark, the left operculum was punched in 2000. The lower operculum

(LOP) was punched in Marshall and the upper operculum (UOP) was punched in Russian Mission. In 2001, the opercular punch was replaced by a punch in the adipose fin.

Selected fish were tagged with pulse-coded radio transmitters in the 150 MHz frequency range (Advanced Telemetry Systems, Isanti, Minnesota). Tag dimensions were 1.8 cm in diameter and 5.2 cm in length in 2000 (Figure 2), and 1.8 cm in diameter and 6.0 cm in 2001. The tag was inserted through the mouth and into the stomach using a plastic tube (0.7 cm diameter) no longer visible. During the insertion, the fish was not anesthetized. The fish was immediately released after tagging and ASL sampling.

### *Remote Tracking and Tag Recovery*

Remote tracking stations (Eiler 1995) were placed on important travel corridors on the Yukon River mainstem and major tributaries (Figure 1 and Appendix B). Stations consisted of a computer-controlled receiver, satellite uplink, and self-contained power system (Figure 3). The receiver detected the presence of radio-tagged fish, and recorded signal strength and activity pattern (active or inactive) of the transmitter, date, time, and location of the fish in relation to the station (i.e., upriver or downriver from the site). When possible, stations were placed on bluffs overlooking straight, narrow, and single-channel sections of the river to maximize receiver reception range, record all the radio-tagged fish passing, and optimize satellite uplink with a geostationary operational environmental satellite (GOES) system. Because tracking sites were located in isolated areas, data were transmitted to the GOES every hour and relayed to a receiving station near Washington D.C. (Eiler 1995). Data were accessed daily via telephone modem and downloaded into an automated database and GIS mapping program (Eiler and Masters 2000).

In 2000, tracking stations were operated at five sites: upriver from the Russian Mission tagging site (Baldhead Mountain), near the mouth of the Koyukuk River, Tanana River, Chena River, and the Yukon River mainstem near Rampart Rapids (Figure 1). In 2001, stations were operated at five sites on the Yukon River mainstem: upriver from the Russian Mission tagging site (Paimiut Hills), Yukon-Anvik River confluence, Yukon-Yuki River confluence, Rampart Rapids, and U.S.-Canada border. Stations were activated near the mouth of the Anvik, Innoko, Koyukuk, and Tanana Rivers, and at the U.S.-Canada border on Porcupine River. Stations were also installed or upgraded at 21 additional sites within the basin in preparation for the full-scale program in 2002. Use of Baldhead Mountain station was discontinued in 2001 because of poor signal reception and atmospheric interference at this site. The Chena River station was not activated in 2001 because of administrative considerations.

Tracking surveys were conducted in the lower river to collect information on movements of the fish immediately after release. Radio-tagged fish were located by helicopter and boat using 4-element Yagi receiving antennas. Surveys extended 10 km downriver to 70 km upriver from the Russian Mission tagging site. Aerial surveys were flown at approximately 500 feet altitude and a speed of 10-15 mph.

Recaptured tagged fish caught at the Marshall and Russian Mission tagging sites were released.

Tagged fish were recovered in salmon escapement and abundance monitoring projects (Appendix C.1 and C.2) and reported voluntarily by commercial and subsistence fishers. To encourage voluntary return of tags, information about the tagging studies and the importance of tag returns was sent to organizations in villages throughout the Yukon River drainage before the field season (Appendix D.1, D.2). A letter of appreciation was sent to each person or agency that returned a tag with information about the fish (Appendix E.1, 2). In each year, the Department conducted a postseason lottery (one $200 prize winner from each of five equal-sized regional groupings of recovered tags, and one $500 prize winner from all people who returned tags).

### *Data Analysis*

#### Daily Abundance Estimation

Catch per unit effort (CPUE) for each drift (number of chinook salmon caught/hour/100-fathom net) was calculated as

$$\text{CPUE} = \frac{c \cdot 6000}{f \cdot t}$$

where $c$ is the number of chinook salmon captured, $f$ is net length in fathoms, $t$ is fishing time in minutes, and 6000 is a conventional multiplying factor.

To provide an estimate of the relative abundance of chinook salmon passing the tagging sites, a weighted average CPUE for day $d$ was calculated as

$$\text{CPUE}_d = \frac{\left(\sum c\right) \cdot 6000}{\sum (f \cdot t)}$$

for all drifts made that day.

#### Test for Effects of Nets

To test differences of capture-related injury rates between monofilament and #21 twine nets, the frequency of captured fish was tabulated by injury categories, rate of new injuries (i.e. [number of fish with new injuries]/[number of fish captured]) using Chi-square test.

### *Mark-Recapture Population Estimation*

The mark-recapture study was designed to estimate population abundance of chinook salmon between Marshall (tagging site) and Russian Mission (recapture site). A drainagewide chinook population estimate was planned between the lower Yukon tagging sites (Marshall & Russian Mission) and upriver drainage recapture sites (various upriver weir and fish wheel sites).

Chapman's closed population two-sample mark-recapture estimator (Seber 1982) was employed to estimate the drainagewide chinook population abundance:

$$\hat{N} = \frac{(\hat{C}+1)(M+1)}{R+1} - 1 \tag{1}$$

and its variance was estimated as:

$$\hat{V}[\hat{N}] \cong \frac{(M+1)(\hat{C}+1)(M-R)(\hat{C}-R)}{(R+1)^2(R+2)} \tag{2}$$

where:

$\hat{N}$ = estimated abundance of chinook salmon in Yukon River upstream of the tagging site.

$M$ = the number of chinook salmon tagged.

C = the number of chinook salmon examined at the recapture site.

$R$ = the number of tagged chinook salmon recovered at the recapture site.

**Tests of Mark-recapture Assumptions**

To use the Chapman closed population estimator, the following assumptions must be met:

1. Recruitment of untagged fish does not occur between the tagging and recapture events,
2. Tagging does not affect the fate (mortality, probability of recapture) of a fish,
3. Tagged fish do not lose their marks and all marks are recognized,
4. All fish have an equal probability of capture at the capture sites, or all fish have an equal probability of capture at the recapture locations, or marked fish mix completely with unmarked fish between capture locations.

Assumption (a) was met, because every fish caught upriver in the Yukon drainage must pass through the Marshall tagging site and no recruitment happens between tagging and recapture events. Assumption (b) was not directly testable; however, successful tracking of radio tagged chinook salmon indicates effects of tagging on mortality would be negligible. To examine assumption (c), most fish at the recapture sites were examined for presence of secondary and tertiary marks. For assumption (d), the following violations would be tested and their remedies implemented:

1. Size distribution of chinook salmon differed between the tagging sites and recapture sites.

The violation of 1 above was corrected by censoring out size classes that are smaller than the minimum recaptured size from population estimation.

2. Marked and unmarked ratio may differ among recapture sites.

A Chi-square test was used to examine equality of marked-unmarked ratio among recapture sites. However, because the number of recaptures was very low (less than 10), recapture projects were combined into three regions: upriver, mid-river, and downriver, and equality of the pooled ratio among these three regions was tested. When no difference was found among the three regions, recaptures of all three regions would be combined, which would produce more accurate estimates. When the marked-unmarked ratio differed significantly, an unbiased population abundance estimate is impossible to make.

### *Population Estimation Based on Canadian Run Reconstruction*

Mark-recapture estimates of abundance were compared with other estimates and with indices of abundance for chinook salmon in the Yukon River. The Department has operated numerous escapement-monitoring projects, which include towers, weirs, aerial surveys, mark-recapture, and sonar methodologies. Most are operated on tributaries of the Yukon River, estimating stock specific escapements. Only the hydroacoustic project, located near the village of Pilot Station (river kilometer 205), estimates drainagewide passage (Rich 2001, Pfisterer 2002) comparable to this project's mark-recapture estimate at Marshall. Catch plus escapement of chinook salmon upstream of the mark-recapture project is only an index because not all tributaries were monitored. Highlights of the potential number of chinook salmon spawning in unmonitored systems was useful in trend comparison or used in comparison with a drainagewide estimate. Catches were estimated from postseason subsistence surveys (Brase and Hamner 2002) or tallied from sales receipts (fish tickets) collected after every commercial fishing period.

We also estimated chinook salmon abundance in the Yukon River using the run reconstruction method, which employs harvests, stock composition, and escapement data. Yukon River chinook salmon population consists of three stocks: lower-river (Koyukuk River area), mid-river (Tanana River area), and Canadian. All three stocks are harvested by U.S. fishers in the 6 fishing districts from the mouth of the river (District 1) to the Canadian border (District 5) and Tanana River (District 6). Scale Pattern Analysis (SPA) estimated proportions of each stock harvested in each fishing district (Moore and Lingnau 2002). SPA estimated the proportion of Canadian stocks inriver harvests increased to 100% from district 1 to 5. Estimates of chinook salmon passing the Canadian border and those harvested at each district were available (JTC 2001, Brase and Hamner 2002). Using those data the total Yukon Chinook Salmon run was re-constructed as detailed below.

Assuming exploitation rate is constant across different stocks (i.e., every chinook salmon has an equal chance of being harvested), total number of chinook salmon at the $i$-th (1,…,$i$,…,5) district, $S_i$, is estimated as

$$S_i = hd_i \cdot C_i / hc_i \tag{1}$$

where

$C_i$ = the number of Canadian origin fish present at the $i$-th district
$hd_i$ = total number of chinook salmon harvested at the $i$-th district
$hc_i$ = estimated number of Canadian origin individuals harvested at the $i$-th district reported in Moore and Lingnau (2002)

The number of Canadian origin fish at $i$-th district, $C$, is a sum of the number of Canadian Stock estimated at the US-Canadian border (JTC 2001) and the number of Canadian stock harvested from upriver district 5 to downriver $i$-th district.

$$C_i = C_b + \sum_{i=5}^{i} hc_i \tag{2}$$

where

$C_b$ = number of Canadian Stock estimated at the US-Canadian border

Combining equations (1) and (2), total number of chinook salmon at $i$-th (1,…,$i$,…,5) district, $S_i$, was estimated as

$$S_i = hd_i \left( C_b + \sum_{i=5}^{i} hc_i \right) \Big/ hc_i \tag{3}$$

The total run estimated to pass upstream of Marshall (into District 3) based on stock composition data was calculated for 2000 and 2001. A variance was not estimated though it should be noted stock proportions generally have a CV of from 12% to 100%. Variances and confidence intervals have been estimated for subsistence catches (Brase and Hamner 2001).

# RESULTS

## *Chinook Salmon Capture and Handling*

### Number of Chinook Salmon Captured and Released

In 2000, 760 chinook salmon were captured in Marshall (431) and Russian Mission (329) between 7 June and 13 July (Table 1, Appendix F.1). In Marshall, both the north and south banks were productive and were fished alternately. In Russian Mission, the north bank was more productive than the south bank, and all sites were fished on a rotating basis. Ninety-one fish were radio tagged

(Marshall 27; Russian Mission 64), 584 fish were only spaghetti tagged (Marshall 358; Russian Mission 226), 34 fish died (Marshall 11; Russian Mission 23), 39 fish were released without tagging (Marshall 29; Russian Mission 10), and 12 fish were recaptured (Marshall 6; Russian Mission 6). Although spaghetti tagging was conducted throughout the season, radio tagging was conducted for 20 days, from 11 June to 30 June. Eleven of the 91 transmitters deployed at Russian Mission were experimental tags (Lotek Engineering, Newmarket, Ontario) and were not monitored beyond the tagging site.

In 2001, 2,313 chinook salmon were captured in Marshall (1,294) and Russian Mission (1,019) between 7 June and 20 July (Table 2, Appendix F.2). Of these, 117 fish were radio tagged (Marshall 2; Russian Mission 115), 1,894 fish were spaghetti tagged only (Marshall 1,114; Russian Mission 780), 38 fish died (Marshall 27; Russian Mission 11), 222 fish were released without tagging (Marshall 126; Russian Mission 96), and 42 fish were recaptured (Marshall 25; Russian Mission 17). Spaghetti tags were attached throughout the season, but fish were radio tagged over a seven-day period from 18 June to 24 June. Of the 117 radio-tagged fish, 9 were experimental tags, (Lotek Engineering, Newmarket, Ontario) and were not monitored beyond the tagging site.

In both 2000 and 2001, the number of chinook salmon spaghetti tagged closely matched the daily chinook CPUE (Figure 4).

**Comparison of Capture Methods**

Of the six net configurations used in 2000, three (6.5" mesh size hung at 3:1 and 2:1 ratios and 7.5" mesh size hung at 3:1 ratio) nets were discontinued because of unacceptably high bycatch of chum salmon. The 8.5″ mesh size with 2:1 hanging ratio net had the highest chinook to chum salmon catch ratio (Table 3). Among the three types of net used in 2001, one type (4″ mesh size gillnet Momoi MT fiber, color shade 3, length 37 m, depth 7.6 m, hanging ratio 3:1) was eliminated because of an unacceptably high bycatch of chum salmon. Chinook salmon catch CPUE was higher for monofilament nets however, observed chinook salmon to chum salmon ratio was higher for twine nets (Table 4). Injury rate significantly differed between monofilament and twine nets. Rate of new injuries was significantly higher in the twine net (0.53) than that in the monofilament (0.45) (Chi-square 7.2, df = 1, $P < 0.007$) (Table 5).

**Chinook Salmon ASL Composition**

Most captured fish were age-6 in both years and locations: Marshall 63.4% (n=380) and Russian Mission 56.8% (n=280) in 2000, and 77.2% (n=978) and 75.9% (n=758), respectively in 2001 (Table 6). Based on visual identification, sex ratio was about equal in both years: male 50.5%, female 49.3%, and unknown 0.2% in 2000 (n=675), and male 46.8%, female 51.9%, and unknown 1.3% in 2001 (n=1920). However, visual identification method is not always accurate. The correct classification between visual and surgical identifications was 62% of fish in 2000 (n=103) and 73% of fish in 2001 (n=203) based on fish recovery information. The most common visual error was males misidentified as females (26% in 2000, and 21% in 2001) compared to the opposite (12% in 2000, 6% in 2001).

Mean length of tagged fish was 783 mm ranging from 470 to 1010 mm in 2000 (n=675), and 816 mm ranging from 440 to 1040 mm in 2001 (n=1973). Mean length of radio tagged fish was 780 mm ranging from 490 to 1000 in 2000 (n=91), and 807 mm ranging from 555 to 955 mm in 2001 (n=117).

**Tag Recoveries**

Tagged fishes were recaptured at: 1) Marshall and Russian Mission tagging sites (Table 2); 2) upriver escapement monitoring projects (Table 2); and 3) in U.S. and Canadian fisheries (Table 7). Data from the first two sources were used for mark-recapture population estimation.

Of spaghetti-tagged fish in 2000, 6 were recaptured in Marshall (tagged at Marshall: 6), 6 in Russian Mission (tagged at Marshall: 1; Russian Mission: 5), 38 in various escapement monitoring sites, and 123 from the fishery (Table 2, 7). Of spaghetti-tagged fish in 2001, 25 were recaptured in Marshall (tagged at Marshall: 24; Russian Mission: 1), 17 in Russian Mission (tagged at Marshall: 14; Russian Mission: 3), 68 in various escapement monitoring sites, and 217 from fisheries. Most tags from the fisheries came from subsistence fishers near Tanana (15% of voluntary tag returns) and Holy Cross (13%) in 2000, and from Holy Cross (13% of voluntary tag returns) and Dawson City (9%) in 2001.

The recovery rates of radio-tagged fish did not significantly differ from non-radio tagged fish (Chi-Square test: $P > 0.05$), except for the rate of voluntary recovery in 2001. Rate of voluntary recovery was significantly lower for non-radio tagged fish (Chi-Square = 17.3, df=1, $P < 0.0001$) (Figure 5).

### *Passage Dates and Migration Rates*

Run timing differed among fish of various stocks. Generally, spaghetti-tagged fish bound for Canadian sections of the basin arrived in the earlier part of the run than those recovered at Gisasa River weir (Figure 6). In fact, fish bound for the US/Canada border arrived significantly earlier and swam faster than those bound for Gisasa River (Mann-Whitney Rank-Sum test for 2000 and 2001) (Table 8). Among the radio tagged fish, average swimming speed was 51.3 km/d (± 4.77, 95% CI) in the Tanana River and 52.5 km/d (± 5.34, 95% CI) in the upper Yukon River in 2000; the fastest movement rate was 66.8 km/d. In 2001, average swim speed was 52 km/d in the middle and upper river, and 24 km/d in the lower basin. The fastest speed recorded was 73 km/d for a fish passing the Rampart Rapids.

### *Proportions of Chinook Salmon Among Tributaries*

Of the 91 radio-tagged fish deployed in 2000, 53 fish released from Russian Mission were tracked. Of these, 70% (37) moved upriver to upper reaches of the basin: 28% (15) to Tanana River (875 km from the tagging site), 25% (13) to Canada (849 km from the tagging site) (Table 9). Minimal information is available on fish remaining in the lower and middle reaches of the basin because of limited deployment of tracking stations in these areas and difficulties in detecting fish during aerial surveys, presumably because fish travel deep in the river. Of the 117 radio tags deployed in 2001, 108 tagged fish were tracked. Of these, 97% (105) moved upriver, passing the Paimiut Hill tracking station an average of 2.2 days after the release, and were tracked to upriver areas: 4% (3) to the Anvik River, 4% (3) to the Koyukuk River, 11% (9) upriver of Galena, 28% (23) to Tanana River, and 36% (29) to Canada. Of fish caught in US fisheries (17%, 2000; 20%, 2001), most (78%, 2000; 61%, 2001) were caught in District 3 and Subdistrict 4a fisheries.

### *Mark-Recapture Population Estimate*

**Test of Assumptions**

None of the assumptions were tested for mark-recapture experiments between Marshall and Russian Mission because of the low number of fish recaptured. For the experiments between marking sites and various recapture sites, the following tests were conducted. For a test of equal size distribution between marked and unmarked fish, the minimum MEF size class for recaptured fish was 630 mm for 2000 and 640 mm for 2001, which accounted for 3.26 % for 2001, and 2.14 % for 2002 of all marked fish (Figure 7, Table 10). To equalize size distribution, fish below this minimum size were excluded from the mark-recapture estimate. For the examination of lost tags, from a total of 8,027 chinook salmon examined through various projects, only one chinook salmon was found at Rampart Rapids Video Run Assessment (USFWS) in 2000 (Table 2). In 2001, zero lost tagged chinook salmon was found from a total of 15,765 chinook salmon examined. For test of equal marked-unmarked ratio through the run, the number of recaptures was too low at each site (<10 for 2000, <20 for 2001) to test for equality. For test of equal marked-unmarked ratio among various recapture sites, the ratio among the upriver, mid-river, and down river sites ranged from 0.0052 to 0.0106 in 2000 and from 0.0034 to 0.0075 in 2001 (Table 10); however, no significant difference was found among the three locations (Chi-square = 1.299, $p$ = 0.552: 2000; Chi-square = 1.155, $p$ = 0.561: 2001). Finally, no significant differences were detected on recapture rates among fish in various injury conditions (Chi-square = 4.901, df = 4, $p$ = 0.298 in 2001). The above adjustments and tests show the Chapman estimator can be used for population estimation.

## Abundance Estimates

Chapman abundance estimates based on tagging at Marshall and recovery at Russian Mission were 62,724 (CV = 0.57) for 2000, and 280,925 (CV = 0.45) for 2001. Yukon River drainagewide estimate based on tagging at Marshall and Russian Mission and sum of recoveries at various weir sites was 112,389 (CV = 0.16) for 2000 and 358,098 (CV = 0.14) for 2001 (Table 10). Estimates based on tagging at Marshall and Russian Mission and recovery at each weir location ranged from 21,815 to 118,878 for 2000, and from 228,474 to 528,407 for 2001. Although the estimation between Marshall and Russian Mission could not achieve the targeted precision (i.e. CV < 0.2), a pooled drainagewide estimation did achieve the desired precision. In 2000, based on run-timing distribution of tagged recaptured chinook salmons at recapture sites, some of the recapture projects seemed to end prematurely. This premature end was corrected in 2001 by extending the recapture projects.

### *Abundance Estimates Based on Canadian Run Reconstruction.*

Based on the stock separation method, drainagewide chinook salmon abundance ranged from 25,746 (District 5) to 112,709 (District 2) in 2000, and from 67,388 (District 5) to 335,035 (District 1) in 2001 (Table 11). Because the Russian Mission and Marshall tagging sites are located near the border between District 2 and District 3, drainagewide estimate upriver of the tagging sites was an average of District 2 and District 3 abundance estimates: 106,202 in 2000 and 308,497 in 2001.

# DISCUSSION/RECOMMENDATIONS

Results of the 2000 and 2001 preliminary studies demonstrated a full-scale radio telemetry study in 2002 will be feasible because: 1) adequate numbers of fish can be captured by drift nets, 2) capturing and radio tagging did not seem to influence behavior of fish, 3) receivers were able to record the signal sufficiently to analyze movement patterns and proportion of marked fish among tributaries, and 4) precision of the mark-recapture population estimation from pooled recoveries met the target precision (i.e. CV < 0.2). Simultaneously, these feasibility studies provided results to improve the successive studies, some of which will be implemented in the 2002 study.

### *Chinook Salmon Capture and Handling*

To minimize capturing and handling stress, chinook salmon should be captured efficiently, selectively, with minimum injuries, minimal handling time and with maximum care. Drift gillnets were an effective method for capturing chinook salmon because they target chinook salmon and allow other species (e.g. chum salmon) to escape. Among the net configurations tested, 8.5″ mesh size with 2:1 hanging ratio seemed to be the most selective and effective, with higher chinook:chum ratio and higher CPUE (Table 4). In comparisons between the monofilament nets and the thicker and softer #21 seine twine nets, the twine nets had lower CPUE and caused more injuries than monofilament nets although most injuries were minor (Table 5). The minor injuries observed did not seem to substantially affect post-tagging fish behavior. However, the twine nets were more selective in catching chinook salmon than the monofilament net (Table 4). These data suggest the seine twine nets are more suitable for catching chinook salmon. Since sufficient numbers of fish can be caught, fishers should minimize handling time and select the best fish for tagging by reducing the number of fish handled per drift. Finally, since visual sex determination tended to overestimate the percentage of females, the ratio should be regarded as unreliable. To estimate the ratio conservatively, only obviously distinguishable fish should be assigned sex.

### *Radio Telemetry*

The information obtained on movement pattern and migration rates suggest large radio tagging programs in the Yukon River basin are feasible. No major behavioral (e.g., migration pattern) differences were observed between tagged and untagged fish, supporting the primary assumption tagged fish behave like untagged fish once released. Most (70% in 2000 and 97% in 2001) fish resumed upriver movements after release and were later located further upriver, although results in 2000 were based on incomplete coverage. Movement rates observed during the study were similar to rates estimated for pulses of untagged fish (48-56 km/d) traveling between village fisheries in the drainage (T. Vania, ADF&G, personal communication), and comparable to the movement rates exhibited by radio-tagged chinook salmon tagged in the upper basin (53.4 km/d) in 1998 (Eiler and Holder in press).

Fish were only radio tagged during a portion of the runs in 2000 and 2001, and the proportions of fish tracked to different reaches of the basin (e.g., proportions among tributaries) do not reflect the distribution of the entire return. However, consistency of proportions among tributaries between 2000 and 2001 (Table 9) suggests more accurate run apportionment is feasible. Technical improvements made in the transmitters and the receiving system, and deployment of additional tracking stations within the basin will further improve tracking capability and understanding of the fate of tagged fish, as evidenced by the reduction of the percentage of "Not located" fish from 2000 to 2001.

### *Chinook Salmon Abundance Estimates*

One of the difficulties of an abundance estimation project is verification of results. In a field situation, some statistical assumptions may be violated if assumed without verification. Violation of these assumptions leads to biased estimation; however, examining the magnitude of bias is difficult. Thus, abundance estimates made using several methods are trustworthy if they agree. Consistency of estimates among various methods indicates high reliability of the estimate. In this study, several semi-independent methods, (1) mark-recapture, (2) Canadian run reconstruction, (3) main river hydroacoustic sonar with species apportionment, and (4) spawning escapement observations combined with harvests were employed.

The estimates from the Canadian run reconstruction method, 106,202 in 2000 and 308,497 in 2001 were within the 95% confidence interval of the estimates from the mark-recapture study, 112,389 ± 36,084 in 2000 and 358,098 ± 95,750 in 2001. These two estimates by independent methods were consistent. However, those estimates were much higher than those estimated by the Pilot Station sonar project, which is located downriver of Marshall or that can be accounted for by upriver escapement ground observations and harvest. The Pilot Station sonar project estimated drainagewide chinook salmon abundance above the site at 70,112 ± 6,437 in 2000 and 137,453 ± 15,462 in 2001 (C. Pfisterer, Division of Commercial Fisheries, ADF&G, Fairbanks).

Another index of abundance was created representing the sum of all harvests and ground based chinook salmon escapement projects upriver from both the Pilot Station sonar and mark-recapture projects (Table 12). Since 1995, the department can account for 46% to 80% of chinook salmon estimated to have passed Pilot Station as upriver catch or escapement. The difference in 2000 and 2001 was 22 to 28 thousand chinook salmon. In contrast, the difference between mark-recapture estimates and upriver catch and escapement was 63,000 chinook salmon in 2000 and 249,000 in 2001. The department is not aware of chinook spawning populations currently unmonitored or large undocumented harvests that could account for the large difference in 2001. A full-scale study with aerial surveys planned in 2002 may be able to address the question of mainstem spawning.

Mark-recapture and run-reconstruction estimates also suggested the run increased 2.9-3.2 times from 2000 to 2001. This increase is similar to that observed in the US/Canada border mark-recapture estimate (3.2) and Salcha River (2.9) tower count, but higher than that observed for escapements in Chatanika River (2.2), Pilot Station (2.0), Chena River (2.0), and Gisasa River (1.5) (JTC 2001). For the mark-recapture abundance estimate, the increase the second year is caused by the similar marked to unmarked ratio between 2000 and 2001. Despite a threefold increase of deployed tags, the fraction remained the same or became lower. This lower fraction indicates: 1) population increased by 3 times, 2) tagging mortality increased by 3 times, 3) recovery crews missed more marked fish. Since catching, handling, and recovering techniques did improve from 2000 to 2001, an increase in handling errors (e.g., increase of tagging mortality and failure to count tagged fish at recovery projects) is unlikely. While the number of voluntary tag returns doubled, the relationship of voluntary returns to total estimated subsistence catch remained about the same (~ 3% in 2000, ~4% in 2001).

Causes of these inconsistencies among types of abundance estimates remain unclear. Each method has underlying assumptions, and each project encountered logistic and methodological challenges (see more details in Pfisterer 2002, Brase and Hamner 2002, Moore and Lingnau 2002). For example, the abundance estimate of Canadian stocks may be too robust or vary between years. Simultaneously, behaviors and stock compositions of the Yukon River chinook salmon are not well understood, which would influence abundance estimates. Additional years, and a better understanding of chinook salmon distribution and tributary abundance, will help. Results of the 2002 radio telemetry project will provide information pertaining to contributions of unmonitored stocks to total drainage populations.

### *Recommendations and Changes for 2002 Study*

Based on this 2000-2001 study, following changes will be adopted in the 2002 study:

1. Net configurations will consist of 8.5″ mesh size, 46 m long, 7.6 m deep gillnets hung at a 2:1 ratio and constructed of thicker and softer #21 seine twine. Momoi MT-73, 14-strand multi-monofilament fiber nets, shade 3 in color, will be used as backup nets.
2. The first three chinook salmon collected from the net will be transported in a dip net and immediately placed in the trough of flowing water. Excess fish will be released immediately. Up to two of the three healthy (i.e., no major or bleeding injuries) fish will be processed and radio tagged.
3. Whenever visual sex determination is uncertain, fish will be categorized as "unknown".
4. At least 1,000 chinook salmon will be radio tagged during the 5-weeks that cover over 95% of the run, and 44 tracking stations, including 12 Canadian sites, will be activated.
5. Mark-recapture experiment will use radio-tagged fish.

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## TABLES

Table 1. Chinook salmon captured in drift gillnets at the Marshall and Russian Mission tagging sites, 2000 and 2001.

| | Captured | Spaghetti Tag | Radio Tag | Mortalities | Released | Recaptured |
|---|---|---|---|---|---|---|
| **Year 2000** | | | | | | |
| Marshall | 431 | 358 | 27 | 11 | 29 | 6 |
| Russian Mission | 329 | 226 | 64 | 23 | 10 | 6 |
| **Total** | **760** | **584** | **91** | **34** | **39** | **12** |
| **Year 2001** | | | | | | |
| Marshall | 1,294 | 1,114 | 2 | 27 | 126 | 25 |
| Russian Mission | 1,019 | 780 | 115 | 11 | 96 | 17 |
| **Total** | **2,313** | **1,894** | **117** | **38** | **222** | **42** |

Table 2. Spaghetti tag recoveries by projects using random sampling methods, 2000 and 2001.

| Km from Yukon R. Mouth | Monitoring and Escapement Study (Operator) | 2000 No. Tags | 2000 No. Fish Examined | 2001 No. Tags | 2001 No. Fish Examined |
|---|---|---|---|---|---|
| 274 | Marshall Radio Telemetry (ADF&G [a]) | 6 | 431 | 25 | 1,294 |
| 274 | Marshall Test Fish (Marshall Traditional Council) | 6 | 689 | Did not operate. | |
| 365 | Russian Mission Radio Telemetry (ADF&G) | 6 | 329 | 17 | 1,019 |
| | **District 3 Subtotal** | **18** | **1,449** | **42** | **2,313** |
| | **Projects Upstream of Russian Mission** | | | | |
| 512 | Anvik R. Carcass Survey (ADF&G) | 0 | 240 | 2 | 383 |
| 724 | Kaltag Subsistence Drift Gillnet (City of Kaltag) | Did not operate. | | 3 | 248 |
| 912 | Gisasa R Weir (USFWS [b]) | 10 | 2,089 | 20 | 3,052 |
| 1,570 | Henshaw Ck. Weir (USFWS) | 1 | 98 | 5 | 1,091 |
| | **District 4 Subtotal** | **11** | **2,427** | **30** | **4,774** |
| | | | | | |
| 1,118 | Subdistrict 5A Ichthyophonus Sampling (UW [c]) | Did not operate. | | 2 | 177 |
| 1,276 | Chatanika R. Carcass Survey (ADF&G) | 0 | 37 | 0 | 44 |
| 1,384 | Nenana Test Fish Wheel (ADF&G) | 1 | 184 | 3 | 870 |
| 1,481 | Subdistrict 6C Ichthyophonus Study (UW) | Did not operate. | | 1 | 53 |
| 1,481 | Chena R. Mark/Recapture (ADF&G) | 0 | 359 | Did not operate. | |
| 1,481 | Chena R. Carcass Survey (ADF&G) | 2 | 157 | 1 | 595 |
| 1,553 | Salcha R. Carcass Survey (BSFA [d]) | 0 | 80 | 1 | 308 |
| 1,688 | Goodpaster R. Carcass Survey (ADF&G) | 0 | 180 | Did not operate. | |
| | **Tanana River Subtotal** | **3** | **997** | **8** | **2,047** |
| | | | | | |
| 1,096 | Tozitna R. Carcass Survey (BLM [e]) | Did not operate. | | 0 | 63 |
| 1,176 | Rampart Rapids Video Run Assessment (USFWS) | 2 [g] | 759 | 2 | 2,893 |
| 1,175 | Rampart Rapids Subsistence Fish Wheel (Volunteer) | 3 | 541 | Did not operate. | |
| 1,176 | Rampart Rapids Ichthyophonus Study (UW) | Did not operate. | | 2 | 214 |
| 1,500 | Beaver Creek Weir (BLM) | 2 | 114 | Did not operate. | |
| | **Subdistrict 5b and 5c Subtotal** | **7** | **1,414** | **4** | **3,170** |
| | | | | | |
| 1,981 | US/Canada Border Tagging - White Rock (DFO [f]) | 7 | 1,019 | 8 | 2,482 |
| 1,992 | US/Canada Border Tagging - Sheep Rock (DFO) | 2 | 475 | 6 | 1,487 |
| 2,123 | Dawson City Test Fishery (DFO) | 7 | 761 | 3 | 697 |
| 2,462 | Tatchun Ck. Weir (DFO) | 1 | 241 | Did not operate. | |
| 2,462 | Tatchun Ck. Broodstock Seining (DFO) | Did not operate. | | 2 | 120 |
| 2,808 | Whitehorse Fishway (DFO) | 0 | 693 | 7 | 988 |
| | **Canada Subtotal** | **17** | **3,189** | **26** | **5,774** |
| | | | | | |
| | **Upstream Sites Total** | **38** | **8,027** | **68** | **15,765** |

[a] Alaska Department of Fish and Game.
[b] U.S. Fish and Wildlife Service.
[c] University of Washington, School of Fisheries
[d] Bering Sea Fishermen's Association
[e] Bureau of Land Management.
[f] Canada Department of Oceans and Fisheries.
[g] Does not include one fish with secondary mark but without tag.

Table 3. Drift gillnet CPUE comparison by mesh size and hanging ratio, 2000.

| Mesh size / hanging ratio | Chinook CPUE | Chum CPUE | Chinook:Chum Ratio | Number of Drifts |
|---|---|---|---|---|
| 7.5″ / 2:1 | 22.3 | 37.4 | 0.6 | 213 |
| 8.5″ / 2:1 | 26.0 | 18.2 | 1.4 | 511 |
| 8.5″ / 3:1 | 31.4 | 39.5 | 0.8 | 425 |

Table 4. Drift gillnet CPUE comparison by mesh materials used during adjacent time periods, 2001.

| Mesh material | Chinook CPUE | Chum CPUE | Chinook:Chum Ratio | Number of Drifts |
|---|---|---|---|---|
| 8.5″ Monofilament | 68.2 | 28.7 | 2.4 | 1,047 |
| 8.5″#21 Seine Twine | 53.0 | 9.9 | 5.4 | 159 |

Table 5. Frequency of injury categories between two net types in 2001.

| Injury Category | 8.5″ Monofilament Number | 8.5″ Monofilament Percentage | 8.5″ #21 Seine Twine Number | 8.5″ #21 Seine Twine Percentage |
|---|---|---|---|---|
| No injuries | 1,121 | 43.1 | 122 | 42.5 |
| Minor old injures | 256 | 9.8 | 12 | 4.2 |
| Major old injuries | 114 | 4.4 | 6 | 2.1 |
| Minor new injuries | 980 | 37.6 | 136 | 47.4 |
| Major new injuries | 133 | 5.1 | 11 | 3.8 |
| **Total** | **2,604** | **100** | **287** | **100** |

Table 6. Age composition of chinook salmon captured in drift gillnets at the Marshall and Russian Mission tagging sites, 2000 and 2001.

| Year | Site | Years Old (Percent) 4 | 5 | 6 | 7 | Sample Size |
|---|---|---|---|---|---|---|
| 2000 | Marshall | 1.6 | 28.2 | 63.4 | 6.8 | 380 |
| 2000 | Russian Mission | 1.1 | 33.2 | 56.8 | 9.0 | 280 |
| 2001 | Marshall | 0.8 | 14.0 | 77.2 | 8.0 | 978 |
| 2001 | Russian Mission | 1.8 | 17.2 | 75.9 | 5.0 | 758 |

Table 7. Voluntary chinook salmon tag recoveries by nearest community, 2000 and 2001.

| Km from Yukon R. Mouth | Nearest Community | Number of Tags Recovered 2000 | 2001 |
|---|---|---|---|
| Alaska | | | |
| 259 | Marshall | 3 | 7 |
| 343 | Russian Mission | 7 | 7 |
| 449 | Holy Cross | 16 | 28 |
| 528 | Shageluk | 4 | 2 |
| 510 | Anvik | 5 | 5 |
| 541 | Grayling | 5 | 15 |
| 724 | Kaltag | 3 | 5 |
| 779 | Nulato | 8 | 18 |
| 808 | Koyukuk | 5 | 6 |
| 853 | Galena | 8 | 2 |
| 935 | Ruby | 9[a] | 3 |
| 1,118 | Tanana | 18 | 15 |
| 1,231 | Manley Hot Springs | 0 | 2 |
| 1,344 | Minto | 1 | 3 |
| 1,384 | Nenana | 0 | 2 |
| 1,481 | Fairbanks | 0 | 12 |
| 1,228 | Rampart | 7 | 13 |
| 1,363 | Stevens Village | 5 | 13 |
| 1,500 | Beaver | 2 | 2 |
| 1,613 | Fort Yukon | 2 | 3 |
| 1,708 | Circle | 1 | 4 |
| 1,952 | Eagle | 4 | 4 |
| Canada | | | |
| 2,026 | Old Crow | 1 | 2 |
| 2,123 | Dawson City | 1 | 19 |
| 2,446 | Mayo | 0 | 7 |
| 2,490 | Carmacks | 8 | 3 |
| 2,269 | Pelly Crossing | 0 | 9 |
| 2,578 | Ross River | 0 | 3 |
| 2,808 | Whitehorse | 0 | 1 |
| 2,865 | Teslin | 0 | 2 |
| **Total Tags Recovered** | | **123** | **217** |
| Estimated Subsistence Catch | | 35,916 | 53,509 |

[a] Does not include one fish with opercular punch but without tag.

Table 8. Mean tagging dates and migration rates of spaghetti tagged chinook salmon recaptured at US/Canada border fish wheels and Gisasa River weir, 2000 and 2001.

| Tag Recovery Project | 2000 Mean Date Tagged at Marshall | 2000 Mean Speed to Recovery (km/d) | 2000 Sample Size | 2001 Mean Date Tagged at Marshall | 2001 Mean Speed to Recovery (km/d) | 2001 Sample Size |
|---|---|---|---|---|---|---|
| US/Canada Border Fish Wheels | 19 June [a] | 45.3 [b] | 9 | 23 June [a] | 48.2 [a] | 14 |
| Gisasa River Weir | 4 July | 33.8 | 10 | 4 July | 32.5 | 19 |

[a] Mann-Whitney Rank Sum Test $p < 0.002$
[b] Mann-Whitney Rank Sum Test $P < 0.05$

Table 9. Final locations of radio tagged chinook salmon tagged in the lower Yukon River basin in 2000 and 2001. Tracking station coverage in the basin in 2000 was more limited than in 2001.

| Location | 2000 Number | 2000 Percent | 2001 Number | 2001 Percent |
|---|---|---|---|---|
| Not Located | 16 | 30.2 | 3 | 2.8 |
| Other Locations | | | 33 | 30.6 |
| US Fishery | 9 | 17.0 | 20 | 18.5 |
| Tanana River | 15 | 28.3 | 23 | 21.3 |
| Canada | 13 | 24.5 | 29 | 26.9 |
| **Total** | **53** | **100** | **108** | **100** |

Table 10. Chinook salmon abundance estimate worksheet, 2000 and 2001.

**2000**

| | | | |
|---|---|---|---|
| Initial number marked: | Blue tag | 584 | |
| | Yellow tag | 91 | |
| Censored fish (< 630 MEF) | | -22 | (3.26%) |
| Recaptured and retained at tagging site | | -6 | |
| **Adjusted number marked** | | **647** | |

| | Original Number Examined | Number Censored | Adjusted Number Unmarked | Number Marked | Adjusted Number Examined | Chapman Estimate | CV | Marked Fraction |
|---|---|---|---|---|---|---|---|---|
| **Downriver (Koyukuk)** | | | | | | | | |
| Gisasa R Weir | 2,089 | -72 | 2,007 | 10 | 2,017 | 118,878 | 0.285 | 0.0050 |
| Henshaw Ck Weir | 98 | -12 | 85 | 1 | 86 | 28,187 | 0.569 | 0.0116 |
| **Downriver pooled** | **2,187** | **-84** | **2,092** | **11** | **2,103** | **113,615** | **0.274** | **0.0052** |
| **Mid-river (Tanana/Ramparts)** | | | | | | | | |
| Nenana Test FW | 184 | -- | 183 | 1 | 184 | 59,939 | 0.572 | 0.0054 |
| Beaver Cr Weir | 114 | -14 | 98 | 2 | 100 | 21,815 | 0.491 | 0.0200 |
| **Mid-river pooled** | **298** | **-14** | **281** | **3** | **284** | **46,169** | **0.442** | **0.0106** |
| **Upriver (Canadian)** | | | | | | | | |
| White Rock FW | 1,019 | -152 | 861 | 6 | 867 | 80,351 | 0.350 | 0.0069 |
| Sheep Rock FW | 489 | -47 | 440 | 2 | 442 | 95,687 | 0.496 | 0.0045 |
| Dawson Test | 761 | -1 | 753 | 7 | 760 | 61,640 | 0.329 | 0.0092 |
| Tatchun Cr Weir | 241 | -- | 240 | 1 | 241 | 78,407 | 0.573 | 0.0041 |
| Rapids Subs FW | 506 | -- | 503 | 3 | 506 | 82,133 | 0.443 | 0.0059 |
| Whitehorse Fishway | 693 | -- | 693 | 0 | 693 | | | 0.0000 |
| **Upriver pooled** | **3,709** | **-200** | **3,490** | **19** | **3,509** | **113,723** | **0.214** | **0.0054** |
| **River-wide pooled** | **6,194** | **-298** | **5,863** | **33** | **5,896** | **112,389** | **0.164** | **0.0056** |

-Continued-

Table 10. (Page 2 of 2).

**2001**

| | | | |
|---|---|---|---|
| Initial number marked: | Blue tag | 1,894 | |
| | Yellow tag | 116 | |
| Censored fish (< 640 MEF) | | -43 | (2.14%) |
| Recaptured and retained at tagging site | | 0 | |
| **Adjusted number marked** | | **1,967** | |

| | Original Number Examined | Number Censored | Adjusted Number Unmarked | Number Marked | Adjusted Number Examined | Chapman Estimate | CV | Marked Fraction |
|---|---|---|---|---|---|---|---|---|
| **Downriver (Koyukuk)** | | | | | | | | |
| Gisasa R Weir | 3,052 | -615 | 2,417 | 20 | 2,437 | 228,474 | 0.211 | 0.0082 |
| Henshaw Ck Weir | 1,091 | -195 | 891 | 5 | 896 | 294,215 | 0.376 | 0.0056 |
| **Downriver pooled** | **4,143** | **-810** | **3,308** | **25** | **3,333** | **252,357** | **0.190** | **0.0075** |
| **Mid-river (Tanana/Ramparts)** | | | | | | | | |
| Nenana Test FW | 870 | -- | 867 | 3 | 870 | 428,531 | 0.446 | 0.0034 |
| **Midriver pooled** | **870** | **0** | **867** | **3** | **870** | **428,531** | **0.446** | **0.0034** |
| **Upriver (Canadian)** | | | | | | | | |
| White Rock FW | 2,482 | -335 | 2,140 | 7 | 2,147 | 528,407 | 0.332 | 0.0033 |
| Sheep Rock FW | 1,487 | -154 | 1,327 | 6 | 1,333 | 375,044 | 0.352 | 0.0045 |
| Dawson Test | 697 | -- | 694 | 3 | 697 | 343,415 | 0.445 | 0.0043 |
| Whitehorse Fishway | 988 | -89 | 893 | 6 | 899 | 253,028 | 0.351 | 0.0067 |
| **Upriver pooled** | **5,654** | **-578** | **5,054** | **22** | **5,076** | **434,414** | **0.202** | **0.0043** |
| **Drainage-wide pooled** | **10,667** | **-1,388** | **9,229** | **50** | **9,279** | **358,098** | **0.136** | **0.0054** |

Table 11. Estimated abundance of chinook salmon at each district in 2000 and 2001 based on scale pattern analysis results.

| Location | Total Harvest ($hd_i$) | Canadian Stock Harvest ($hc_i$) | Estimated Percentage | Total Number of Chinook Salmon ($S_i$) |
|---|---|---|---|---|
| **2000** | | | | |
| District 1 | 10,902 | 3,817 | 35.0 | 111,804 |
| District 2 | 14,040 | 4,400 | 31.3 | 112,709 |
| District 3 | 3,914 | 1,214 | 31.0 | 99,694 |
| District 4 | 5,741 | 3,962 | 69.0 | 43,047 |
| District 5 | 8,751 | 8,751 | 100.0 | 25,746 |
| US/Canada Border | 43,3481[a] | 22,144[a] | 51.1[a] | 16,995 |
| **2001** | | | | |
| District 1 | 7,089 | 1,656 | 23.4 | 335,035 |
| District 2 | 13,442 | 3,256 | 24.2 | 316,269 |
| District 3 | 6,361 | 1,506 | 23.7 | 305,222 |
| District 4 | 9,555 | 3,369 | 35.3 | 200,678 |
| District 5 | 13,538 | 13,538 | 100.0 | 67,388 |
| US/Canada Border | 49,985[a] | 23,325[a] | 46.7[a] | 53,850 |

[a] Total US harvest.

Table 12. Run reconstruction of chinook salmon catch and escapement at monitored systems in the Yukon River above District 2.

| | Fishery Harvest Above District 2 | | | Escapement Monitoring Projects Above District 2 | | | | | Canadian Border Estimate | Total Catch and Escapement | Pilot Station Sonar | Mark-Recapture Estimate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Comm. | Subs. | Sport | Nulato | Gisasa | Chatanika | Chena | Salcha | | | | |
| 1995 | 6,488 | 33,937 | 3,225 | 1,412 | 4,023 | | 9,680 | 13,643 | 52,353 | 124,761 | 254,142 | |
| 1997 | 7,863 | 23,196 | 3,404 | 4,766 | 3,764 | | 13,390 | 18,396 | 53,400 | 128,179 | 200,120 | |
| 1998 | 1,480 | 37,393 | 654 | 1,536 | 2,356 | 864 | 4,745 | 5,027 | 22,588 | 76,643 | 134,243 | |
| 1999 | 5,269 | 35,238 | 1,301 | 1,932 | 2,631 | 506 | 6,485 | 9,198 | 23,608 | 86,168 | 187,523 | |
| 2000 | 0 | 20,090 | 277 | 908 | 2,089 | 398 | 4,707 | 3,108 | 16,995 | 48,572 | 72,693 | 112,000 |
| 2001 | 0 | 32,650 | 571 | | 3,052 | 861 | 9,244 | 8,981 | 53,850 | 109,209 | 137,453 | 358,000 |

## FIGURES

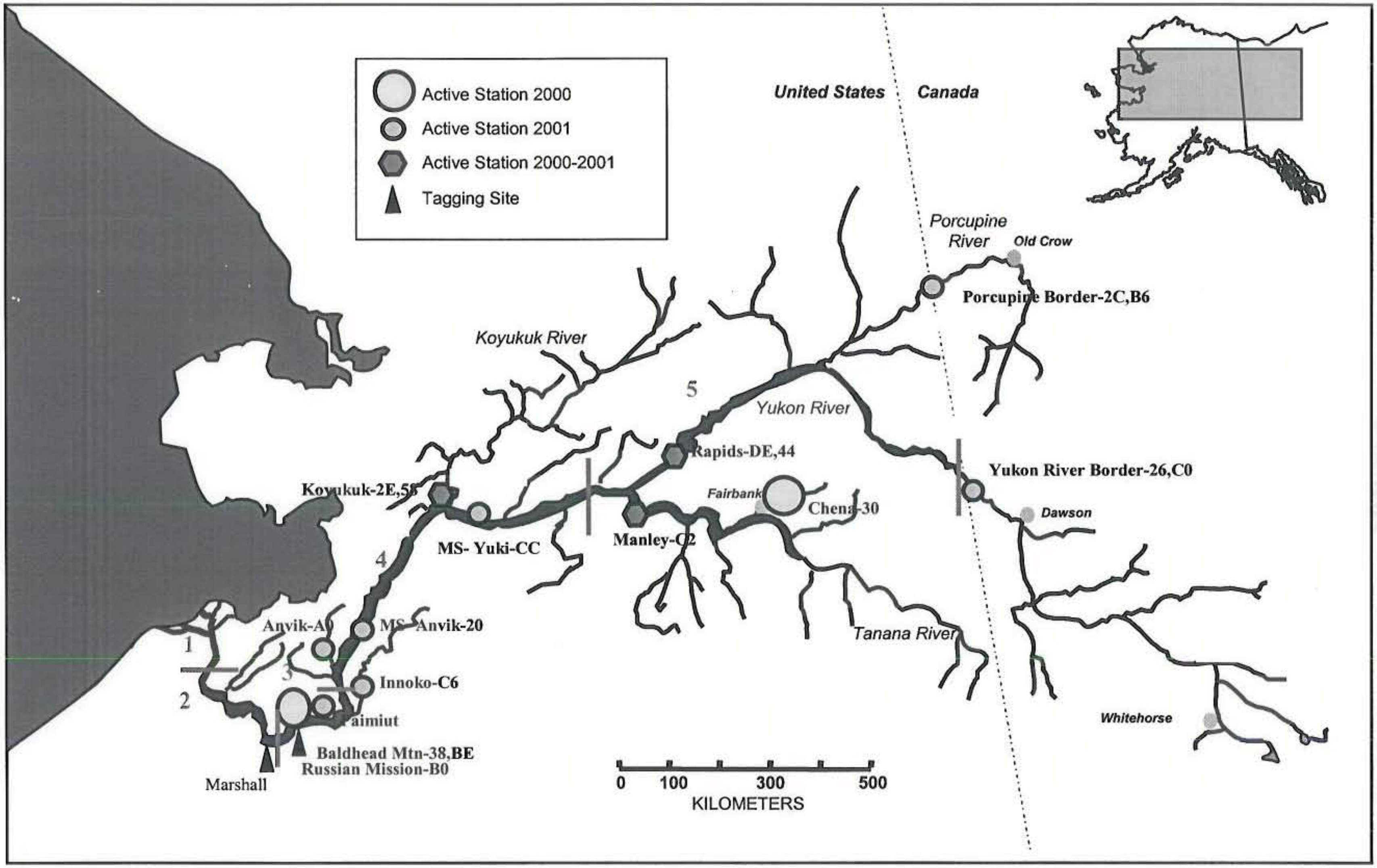



Figure 1. Map of the Yukon River drainage with names (identification number in parantheses), locations, tagging sites, Districts 1-5 and remote tracking stations, 2000 and 2001.

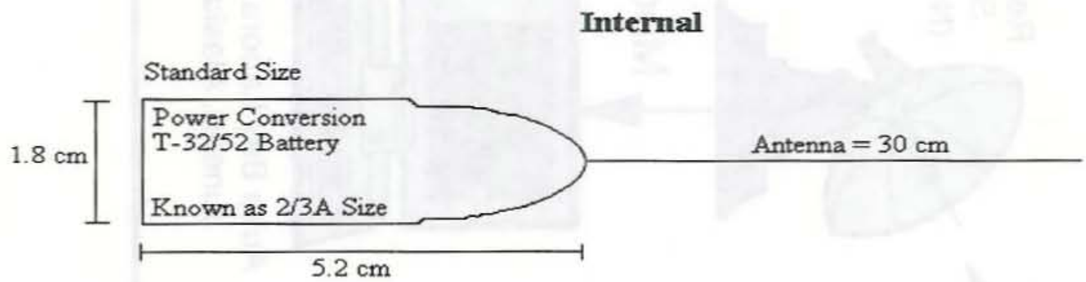



Figure 2. Dimensions and shape of radio transmitters used to tag adult chinook salmon in the Yukon River basin in 2000.

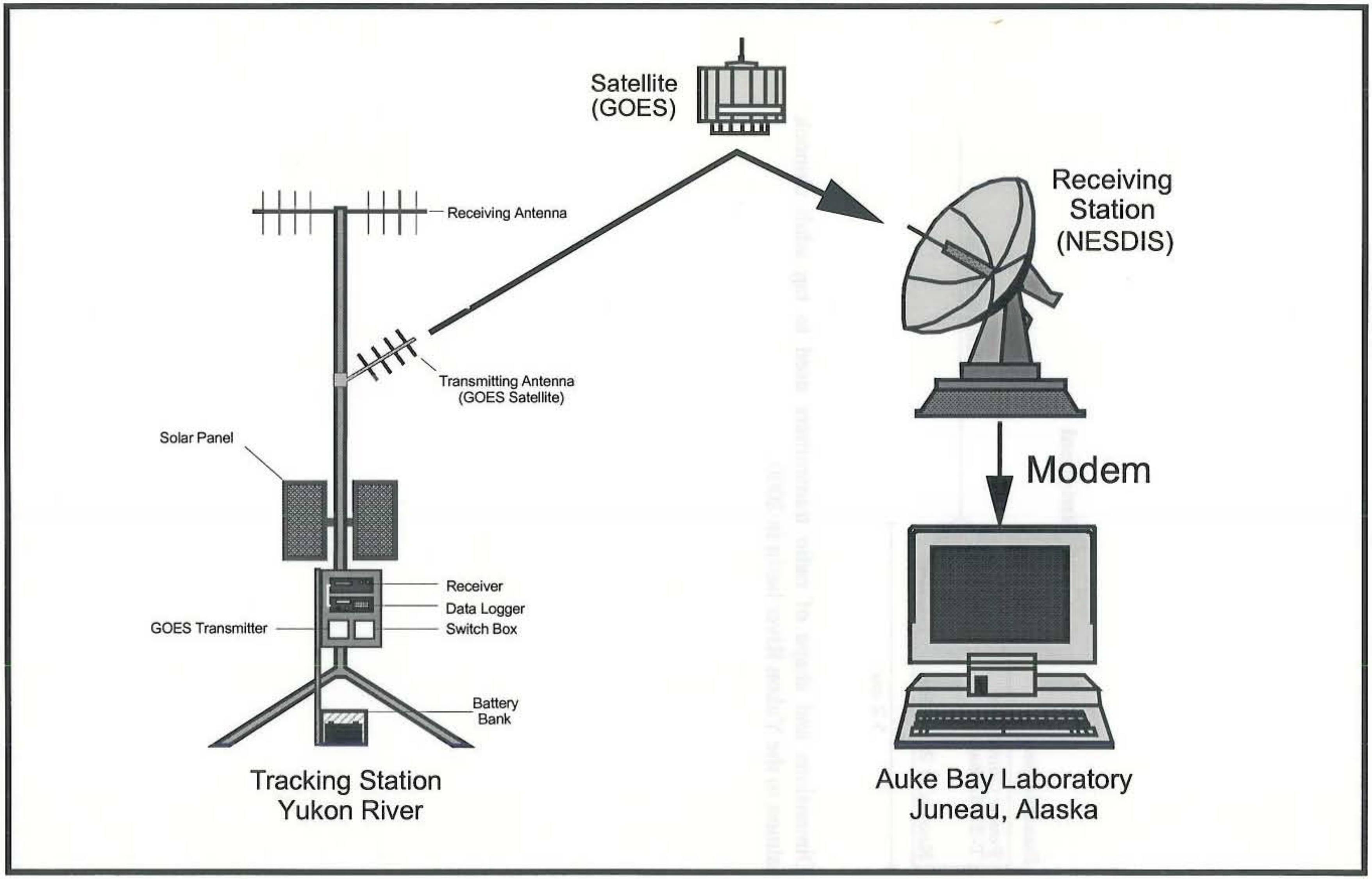



Figure 3. Remote tracking station (RTS) diagram.

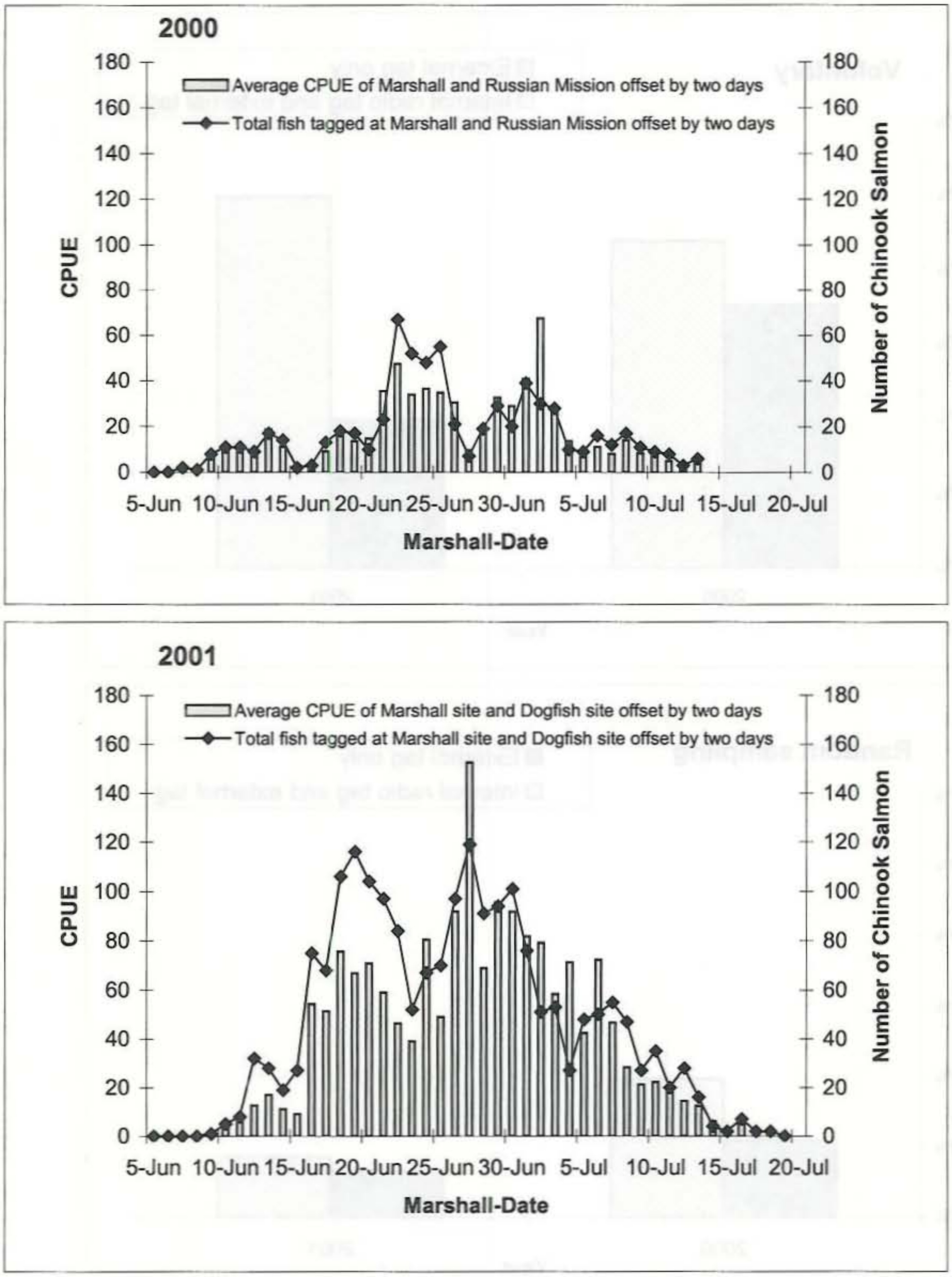



Figure 4. Daily drift gillnet chinook salmon CPUE and number spaghetti tagged, 2000 and 2001.

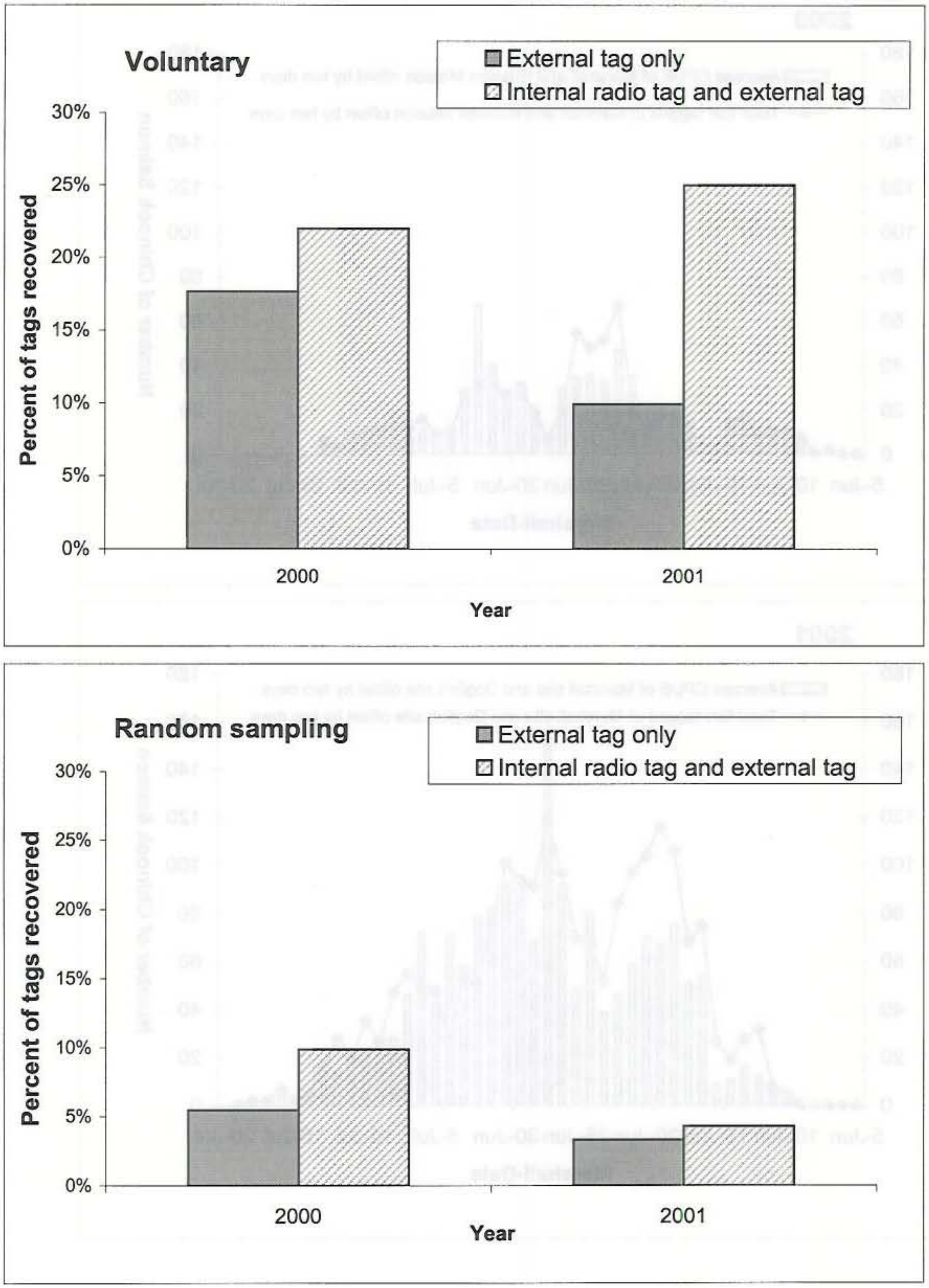
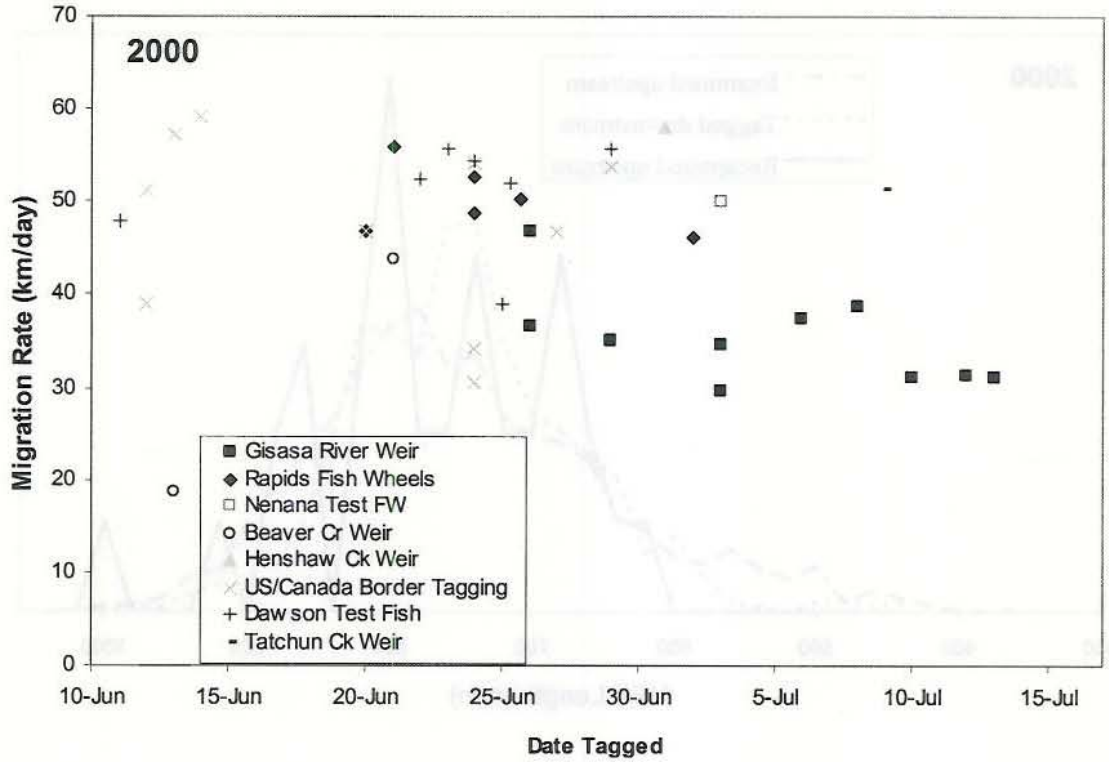



Figure 5. Recapture rates of radio tagged and spaghetti tagged chinook salmon by voluntary and random sampling methods, 2000 and 2001.



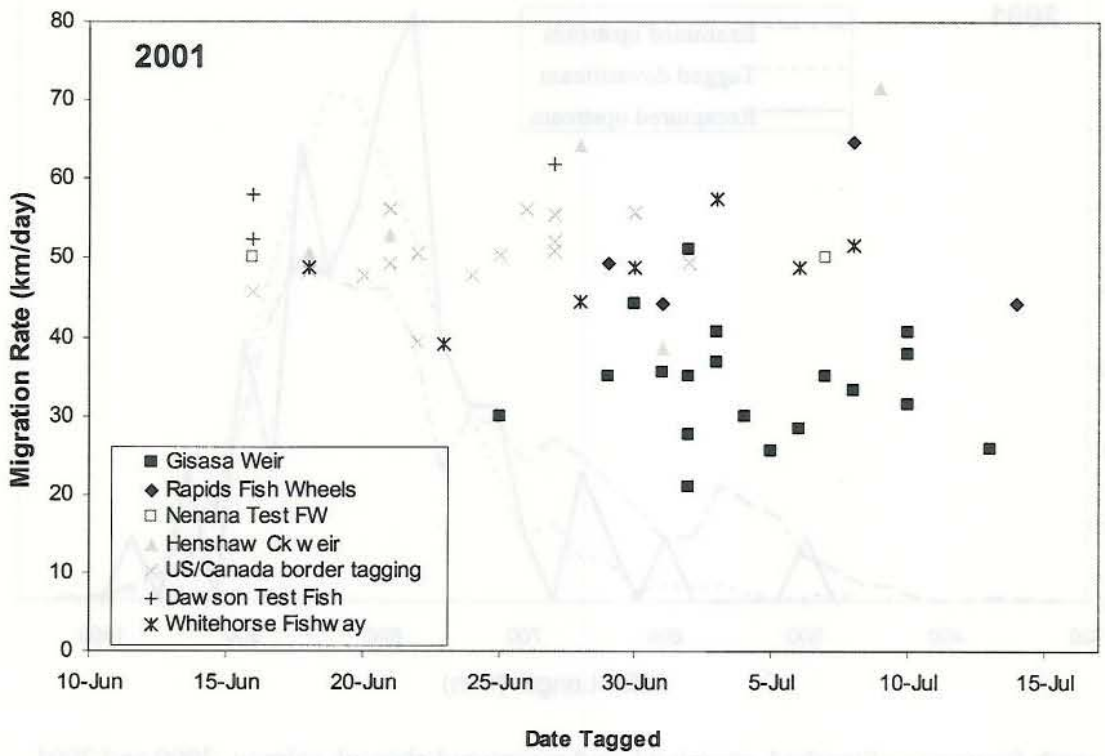
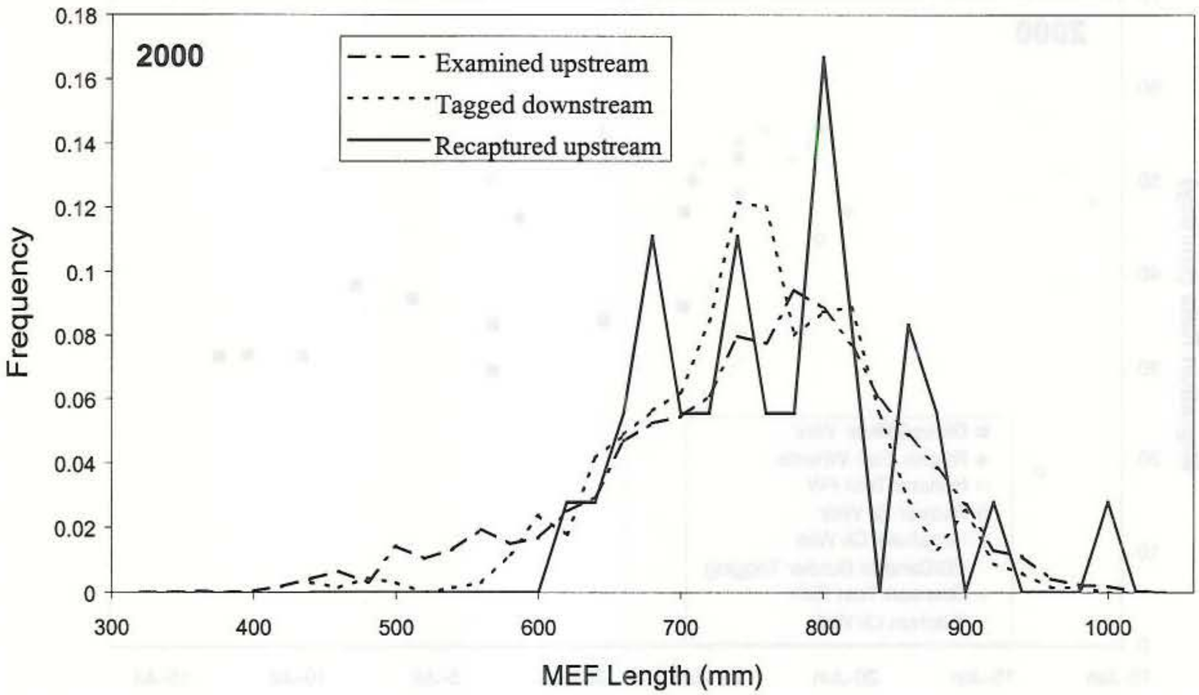




Figure 6. Chinook salmon migration rate vs. date tagged at Marshall, by recovery project, 2000 and 2001.



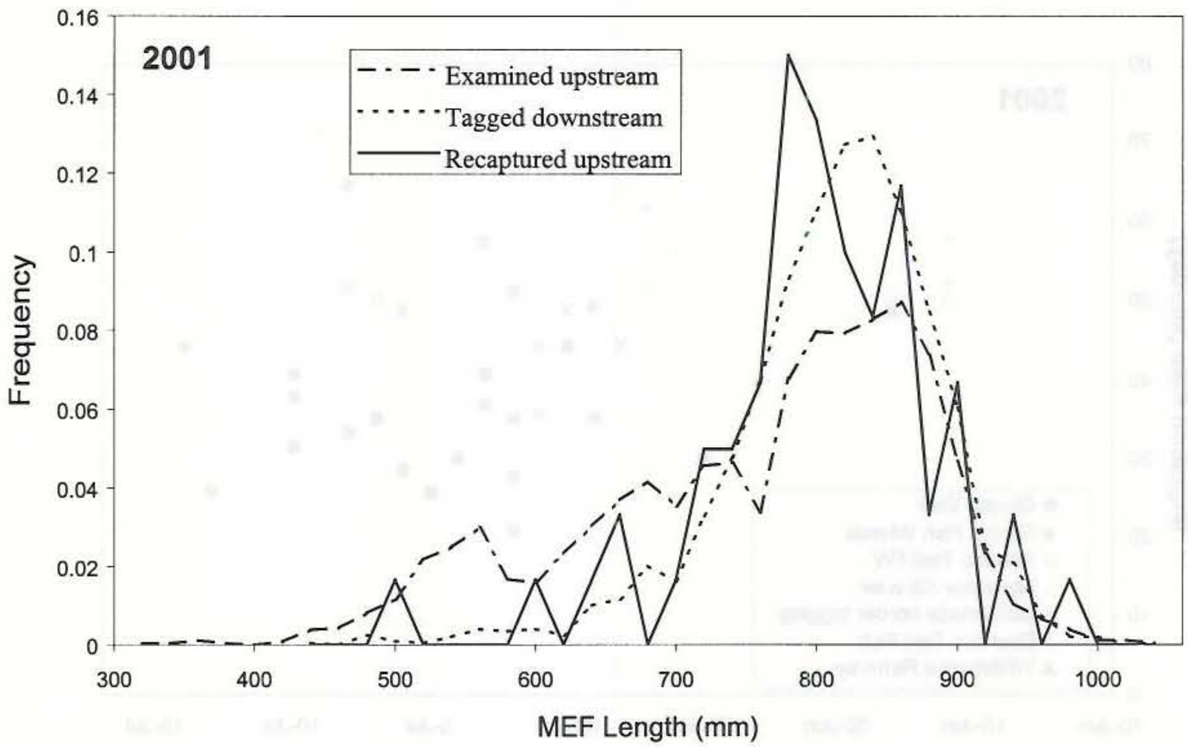




Figure 7. Length frequency of marked, examined, and recaptured chinook salmon, 2000 and 2001.

# APPENDICES

Appendix A. Memorandum of Understanding between Alaska Department of Fish and Game, Division of Commercial Fisheries and U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Auke Bay Laboratory.

**MEMORANDUM OF UNDERSTANDING**

BETWEEN

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF COMMERCIAL FISHERIES

AND

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE
ALASKA FISHERIES SCIENCE CENTER, AUKE BAY LABORATORY

I. INTRODUCTION

Yukon River chinook salmon support important commercial and subsistence fisheries in the U.S. and Canada. Conservation, management, and harvest sharing arrangements have been in negotiation between the two countries since 1985. Recently, the weak returns which occurred throughout western Alaska for many salmon runs resulted in the United States Congress funding a budget initiative for "...the State of Alaska to develop disaster research and prevention relative to the 1998 Bristol Bay, Kuskokwim, and Yukon fishery resource disaster."

The Alaska Department of Fish and Game (hereafter referred to as ADF&G), and the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center, Auke Bay Laboratory (hereafter referred to as NMFS) propose to conduct a cooperative telemetry and mark-recapture research project on chinook salmon returns in the Yukon River basin. In recent years, large scale tagging programs, providing information on abundance, spawning distribution, stock composition and movement patterns, have been conducted successfully by NMEFS and the U.S. Fish and Wildlife Service in the upper Yukon River basin for chum salmon. This infrastructure provides the framework for this expanded work on chinook salmon in the Yukon River basin.

II. PURPOSE:

This Memorandum of Understanding (MOU) is created to establish an arrangement between ADF&G and NMFS to conduct cooperative Yukon River salmon research.

III. AUTHORITY:

This MOU is made in accordance with ADF&G and NMFS policy to support the U.S./Canada Pacific Salmon Treaty Negotiations as participants and providers of technical information and expertise.

IV. AGREEMENT:

A. The Alaska Department of Fish and Game will:

Provide equipment and supplies including radio tags and radio tracking equipment, and personnel to support this program;

Coordinate operational aspects of the program to include funding contracted programming services for extending the upper Yukon River Basin geographical information system (GIS) to the lower and middle portions of the drainage;

Be responsible for all aspects related to capturing salmon for tagging, including the establishment of capture methods and procedures;

Collect, analyze and summarize fish capture data, and prepare annual summaries;

Provide weekly and total run abundance estimates of Yukon River chinook salmon post season, based upon mark-recapture or other acceptable methods;

Produce publications on fish capture and abundance estimates jointly authored with NMFS;

Develop joint annual operational plans with NMFS

B. The National Marine Fisheries Service will:

Provide NMFS owned telemetry equipment and tracking system infrastructure currently in use in the upper Yukon River basin;

Be responsible for all aspects related to the telemetry component of the program, including the establishment of tagging and tracking procedures, and the satellite uplink established through the National Environmental Satellite and Data Information System (NESDIS);

Provide oversight for all ADF&G purchases of telemetry equipment to ensure suitability and compatibility with existing infrastructure;

Provide technical support to extend the GIS mapping program developed for the upper Yukon River Basin to include the lower and middle portions of the drainage to facilitate data summarization and analysis, and simplify dissemination of telemetry information;

Collect, analyze, and prepare annual summaries of telemetry data;

Determine spawning distribution, run timing, movement patterns, handling response, and identify undocumented spawning areas for Yukon River salmon, and develop stock composition estimates by nation of origin and sub-basin by weighting telemetry data with weekly abundance estimates developed by ADF&G;

Produce publications on telemetry data jointly authored with ADF&G; Develop joint annual operational plans with ADF&G.

## V. AGREEMENT TERM:

The terms of this agreement will become effective upon the signatures of the approving officials of the respective agencies entering into this agreement. This MOU will remain in force for the effective funding period of the Western Alaska Fisheries Disaster Mitigation Research Plan.

## VI. SPECIAL PROVISIONS:

F. Any transfer of funds, property, or services by ADF&G or NMFS will be accomplished in accordance with applicable laws, regulations, and procedures.

G. This MOU may be modified or amended as necessary upon written consent of both parties or may be terminated by either party with a 60 day written notice to the other party.

H. The principle contacts for this MOU are:

Alaska Department of Fish and Game, Commercial Fisheries Division

Doug Eggers, Chief Fisheries Scientist
P.O. Box 25526
Juneau, Alaska 99802-6199
Telephone: (907) 465-6117 e-mail: doug_eggers@fishgame.state.ak.us
FAX: (907) 465-2604

Tom Kron, AYK Regional Supervisor
333 Raspberry Road
Anchorage, Alaska 99518-1599
Telephone: (907) 267-2166 e-mail: tom_kron@fishgame.state.ak.us
FAX: (907) 267-2442

Larry Buklis, AYK Regional Research Biologist
333 Raspberry Road
Anchorage, Alaska 99518-1599
Telephone: (907) 267-2122 e-mail: larry_buklis@fishgame.state.ak.us
FAX: (907) 267-2442

Jeff Bromaghin, AYK Regional Biometrician
333 Raspberry Road
Anchorage, Alaska 99518-1599
Telephone: (907) 267-2379 e-mail:jeff_bromaghin@fishgame.state.ak.us
FAX: (907) 267-2442

Russ Holder, AYK Regional Resource Development Biologist
1300 College Road
Fairbanks, Alaska 99701-1599
Telephone: (907) 459-7288 e-mail: russ_holder@fishgame.state.ak.us
FAX: (907) 452-1668

National Marine Fisheries Service

James W. Balsiger, Science and Research Director
Alaska Fisheries Science Center
7600 Sandpoint Way NE
Seattle, WA 98115-0070
Telephone: (206) 526-4000 e-mail: jim.balsiger@noaa.gov
FAX: (206) 526-4004

Michael Dahlberg, Director
Auke Bay Laboratory
11305 Glacier Highway
Juneau, AK 99801
Telephone: (907) 789-6001 e-mail: mike.dahlberg@noaa.gov
FAX: (907) 789-6094

Richard Wilmot, Research Geneticist
Auke Bay Laboratory
11305 Glacier Highway
Juneau, AK 99801
Telephone: (907) 789-6079 e-mail: richard.wilmot@noaa.gov
FAX: (907) 789-6094

John Eiler, Project Leader
Auke Bay Laboratory
11305 Glacier Highway
Juneau, AK 99801
Telephone: (907) 789-6033 e-mail: john.eiler@noaa.gov
FAX: (907) 789-6094

In Witness to Whereof, the parties undersigned below have caused this Memorandum of Understanding to be executed as of the date of last signature below:

APPROVED:

ALASKA DEPARTMENT OF FISH & GAME

BY: Kerri Brooks
for Frank Rue

TITLE: Commissioner, Alaska Dept. of Fish and Game

DATE: 10.21.99

BY: Robert D. Mecum
Robert D. Mecum

TITLE: Director, Division of Commercial Fisheries

Date: 10/10/99

BY: Tom Kron
Tom Kron

TITLE: Regional Supervisor, Arctic-Yukon-Kuskokwim

DATE: 10/19/99

NATIONAL MARINE FISHERIES SERVICE
ALASKA FISHERIES SCIENCE CENTER

BY:
James W. Balsiger

TITLE: Science and Research Director

DATE:

Appendix B. Remote tracking station locations and site landowners.

| ID | Location | Latitude | Longitude | Landowner | Active in 2000 | Active in 2001 |
|---|---|---|---|---|---|---|
| 38 | MS Yukon R at Baldhead Mtn- Downstream | 61.9303 | -160.9883 | Russian Mission Native Corp | x | |
| BE | MS Yukon R at Baldhead Mtn- Upstream | 61.9303 | -160.9883 | Russian Mission Native Corp | x | |
| B0 | MS Yukon R at Dogfish tagging camp | 61.9198 | -160.9987 | Native allotment | x | x |
| 38 | MS Yukon R at Paimiut- Downstream | 61.9616 | -160.3446 | BLM | | x |
| BE | MS Yukon R at Paimiut- Upstream | 61.9634 | -160.3151 | BLM | | x |
| C6 | Innoko R | 63.0727 | -159.0518 | State of AK/ DNR | | x |
| BA | Bonasila R | 62.5399 | -160.2640 | Deloy Ges Corp | | |
| A0 | Anvik R | 62.6539 | -160.4528 | Deloy Ges Corp | | x |
| 20 | MS Yukon R at Anvik | 62.7885 | -160.0796 | Deloy Ges Corp | | x |
| 56 | Nulato R | 64.7278 | -158.2040 | Native allotment | | |
| 2E | Lower Koyukuk R- Downstream | 65.0223 | -157.5410 | Koyukuk NWR | x | x |
| 58 | Lower Koyukuk R- Upstream | 65.0226 | -157.5405 | Koyukuk NWR | x | x |
| 3E | Gisasa R | 65.2595 | -157.7320 | Koyukuk NWR | | |
| 2A | Hogatza R | 66.0063 | -155.3651 | State of AK/ DNR | | |
| 5C | Upper Koyukuk R | 65.9049 | -155.2146 | Koyukuk NWR | | |
| CC | MS Yukon R at Yuki R | 64.7261 | -156.1434 | State of AK/ DNR | | x |
| B2 | Melozitna R | 64.7912 | -155.5575 | Dineega Corp | | |
| B8 | Nowitna R | 64.6579 | -154.5059 | Nowitna NWR | | |
| CE | Tozitna R | 65.1566 | -152.4343 | Tozitna, Ltd | | |
| C2 | Lower Tanana R at Manley- Downstream | 64.9790 | -150.8231 | State of AK/ DNR | x | x |
| C4 | Lower Tanana R at Manley- Upstream | 64.9795 | -150.8223 | State of AK/ DNR | | |
| | Mid-Tanana R at Cosna Bluff | 64.8868 | -151.2790 | Permit denied by private owner | | |
| DA | Mid-Tanana R upstream of Nenana | 64.5817 | -148.9240 | Private owner | | |
| 30 | Chena R | 64.7900 | -147.1800 | US Army/COE | x | |
| 3C | Salcha R | 64.4787 | -146.8890 | State of AK/ DNR | | |
| AC | Upper Tanana R | 64.2580 | -146.2896 | State of AK/ DNR | | |
| DE | MS Yukon R at Rampart Rapids- North Bank | 65.3911 | -150.9084 | NMFS permitting | x | x |
| 44 | MS Yukon R at Rampart Rapids- South Bank | 65.3811 | -150.8932 | NMFS permitting | x | x |
| 4E | Chandalar R | 66.7000 | -146.0400 | NMFS permitting | | |
| A2 | Porcupine R | 66.9700 | -142.7600 | NMFS permitting | | |
| A8 | Black R near Chalkyitsik | 66.6500 | -143.7200 | NMFS permitting | | |
| BC | Sheenjek R | 66.7900 | -144.4600 | NMFS permitting | | |
| 2C | Porcupine R at US/Canada Border- Downstream | 67.3730 | -141.1658 | NMFS permitting | | x |
| B6 | Porcupine R at US/Canada Border- Upstream | 67.3788 | -141.1285 | NMFS permitting | | x |
| 32 | Fishing Branch R | 66.5300 | -139.2500 | NMFS permitting | | |
| D4 | MS Yukon R at Circle | 65.5800 | -143.8100 | NMFS permitting | | |
| 26 | MS Yukon R at US/Canada Border- Downstream | 64.3758 | -140.3998 | Canada/DFO permitting | | x |
| C0 | MS Yukon R at US/Canada Border- Upstream | 64.3747 | -140.3792 | Canada/DFO permitting | | x |
| 4A | Stewart R | 63.2667 | -139.2000 | Proposed for 2002 | | |
| 28 | MS Yukon R at White R | 63.2167 | -139.7667 | Proposed for 2002 | | |
| 52 | Kluane R | 61.7767 | -139.4880 | Canada/DFO permitting | | |
| 5A | MS Yukon R near Fort Selkirk | 62.8318 | -137.7230 | Canada/DFO permitting | | |
| 5E | Pelly R | 62.8667 | -137.2333 | Proposed for 2002 | | |
| 24 | MS Yukon R at Tatchun Ck | 62.2969 | -136.3160 | Canada/DFO permitting | | |
| 36 | Big Salmon R | 61.8833 | -134.8167 | Proposed for 2002 | | |
| C8 | Teslin R | 61.5333 | -134.8833 | Proposed for 2002 | | |
| 40 | MS Yukon R near Hootalinqua | 61.5667 | -135.9667 | Proposed for 2002 | | |

Appendix C.1. Tag recovery forms sent to random sampling projects, 2000.

# ALASKA DEPARTMENT OF FISH AND GAME

## YUKON RIVER CHINOOK SALMON TAG RECOVERY INSTRUCTIONS

To generate run abundance estimates, accurate records of the number of untagged and tagged fish passing each assessment site, must be collected.

1) ALL fish are examined for tags and secondary marks. Record total number of kings examined for secondary marks.
2) Record total number of kings captured and total hours fished per day.
3) Record total number of males and total number of females captured per day.
4) Record total number of tagged kings.
5) Record total number of secondary marked kings. All tagged kings will have a secondary mark in case the spaghetti tag is lost. **It is important that all fish, whether visually spaghetti tagged or not, are examined for a secondary mark to determine the extent of tag loss.**
6) Record total number of tagged kings and number of secondary marked kings.
7) Tag recovery information should include:
   a) Tag number
   b) Tag color
   c) Sex of fish
   d) Secondary Mark – Check box indicating upper or lower operculum punch
8) Comments should include:
   a) If the fish has a yellow tag, is the radio present?
   b) General condition of the fish (color, wounds, fungus present?)

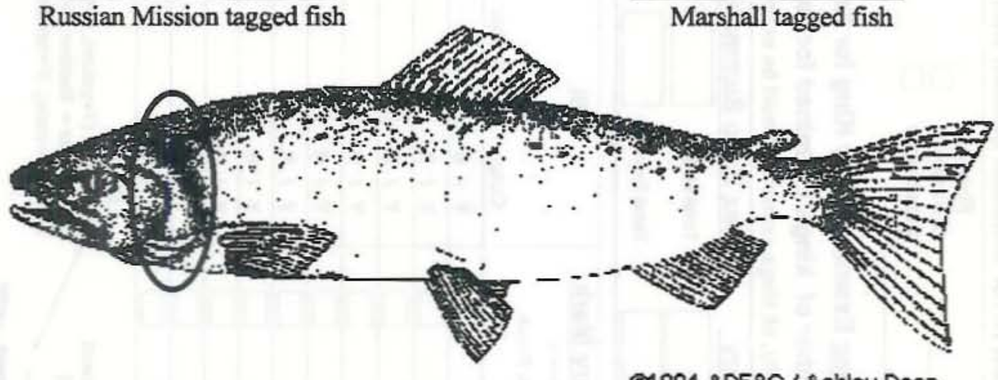
**Spaghetti tags associated with this project will be either light blue or yellow in color. Chinook salmon tagged with radio tags will have yellow spaghetti tags, but all other fish will have light blue spaghetti tags.**

**Operculum Punch Secondary Mark**

A small hole will be punched into the operculum.

UPPER OPERCULUM
Russian Mission tagged fish

LOWER OPERCULUM
Marshall tagged fish





All Tagged Fish Have A Secondary Mark Located On The Left Side Of The Fish.

-Continued-

## Yukon River Chinook Salmon Daily Tag Recovery Data, 2000

Date: ___/___/00

Name: ____________________

**Fishery**
Commercial ☐
Subsistence ☐

**Gear Type**
Fish Wheel ☐
Set Gillnet ☐
Drift Gillnet ☐

**Location** ☐

**Please Examine Every King for Secondary Marks**

**Number of kings examined for secondary marks** ☐

**( Ideally, all kings captured should be examined for secondary marks)**

**Daily Catch Summary**

Total Kings Captured ☐

Total Hours Fished ☐

**Sex Ratio Summary**

Total Males ☐

Total Females ☐

**Recapture Summary**

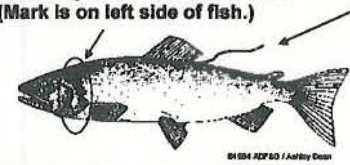
Number of Tagged Kings ☐

Number of Secondary Marked Kings ☐

| Fish Number | Secondary Mark (Check if present) Operculum Punch Upper | Lower | Tag Color | Number | Sex | Comments |
|---|---|---|---|---|---|---|
| 1 | ☐ | ☐ | Y / B | | M / F | |
| 2 | ☐ | ☐ | Y / B | | M / F | |
| 3 | ☐ | ☐ | Y / B | | M / F | |
| 4 | ☐ | ☐ | Y / B | | M / F | |
| 5 | ☐ | ☐ | Y / B | | M / F | |
| 6 | ☐ | ☐ | Y / B | | M / F | |
| 7 | ☐ | ☐ | Y / B | | M / F | |
| 8 | ☐ | ☐ | Y / B | | M / F | |
| 9 | ☐ | ☐ | Y / B | | M / F | |
| 10 | ☐ | ☐ | Y / B | | M / F | |

**KEY**

**Secondary Mark:** Check if present.
**(Mark is on left side of fish.)**



**Tag Color** = (Y=yellow), (B=blue)
**Tag Number** = Number printed on tag
**Sex** = (M=male), (F=female)

**Return Data Forms TO:**

Alaska Department of Fish and Game
Commercial Fisheries
1300 College Road
Fairbanks, Alaska 99701

Contact Person: Bill Busher (459-7293)

TagData.xls/Field/TagABL Form

Appendix C.2. Tag recovery forms sent to random sampling projects, 2001.

*ALASKA DEPARTMENT OF FISH AND GAME*
YUKON RIVER CHINOOK SALMON TAG RECOVERY INSTRUCTIONS

To generate run abundance estimates, accurate records of the number of untagged and tagged fish passing each assessment site must be collected daily.

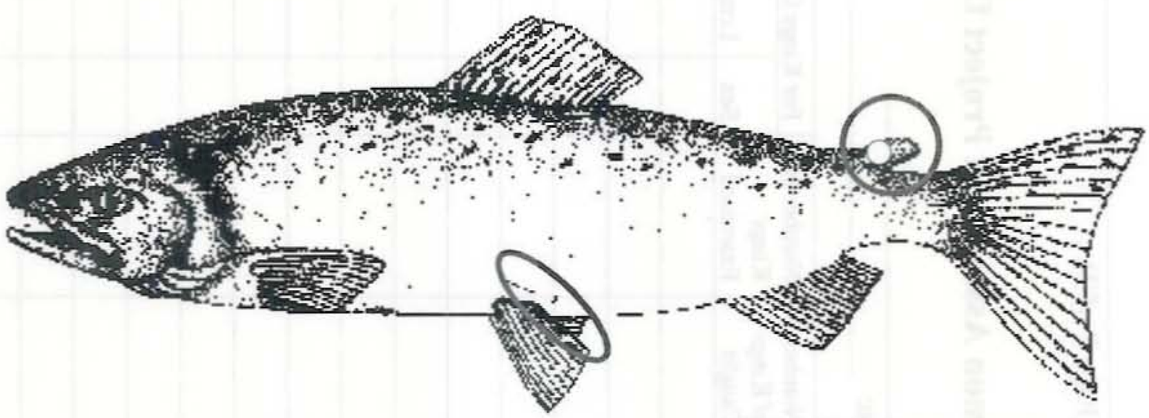
Record type of gear used to capture king salmon and location of the assessment project.
Record date and number of hours the gear was operated that day.
Record the total number of kings **caught** that day and the number of kings **examined** for tags and secondary marks. Ideally, **all** kings captured will be examined for secondary marks.
For each king observed with a tag or a secondary mark, record:
Sex c) Tag Color e.) Did the adipose fin have a hole punched through it?
Length d) Tag Number f.) Was the left or right axillary fin removed? (L / R)
Comments about each tagged or secondary marked fish should include:
If the fish has a yellow tag, is the radio present?
General condition of the fish (color, wounds, fungus present?)

**It is important that all kings, whether spaghetti tagged or not, are examined for secondary marks to determine the extent of tag loss. Spaghetti tags associated with this project will be either light blue or yellow in color. Chinook salmon with internal radio tags will have yellow spaghetti tags, but all other tagged kings will have light external spaghetti tags.**

**Secondary marks to look for:**
**ADIPOSE FIN PUNCH**
A small hole will be punched into the adipose fin.

**LEFT AXILLARY PROCESS**
**Removed from fish tagged in Marshall.**

**RIGHT AXILLARY PROCESS**
**Removed from fish tagged in Russian Mission.**





# All Tagged Fish Have A Punched Adipose Fin.

-Continued-

Appendix C.2. (Page 2 of 2).

## Chinook Salmon Assessment Project Daily Tag Recovery Data Form, 2001

Gear Type: ______________________

Detailed Location: ______________________

| Date | Hours Fished | Number of Kings Caught | Number of Kings Examined | For Kings Observed with Tags and/or Secondary Marks | | | | | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Sex | Length | Tag Color | Tag Number | Adipose Punch? | Axillary Clip? | |
| | | | | | | | | | L R | |
| | | | | | | | | | L R | |
| | | | | | | | | | L R | |
| | | | | | | | | | L R | |
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| | | | | | | | | | L R | |
| | | | | | | | | | L R | |
| | | | | | | | | | L R | |

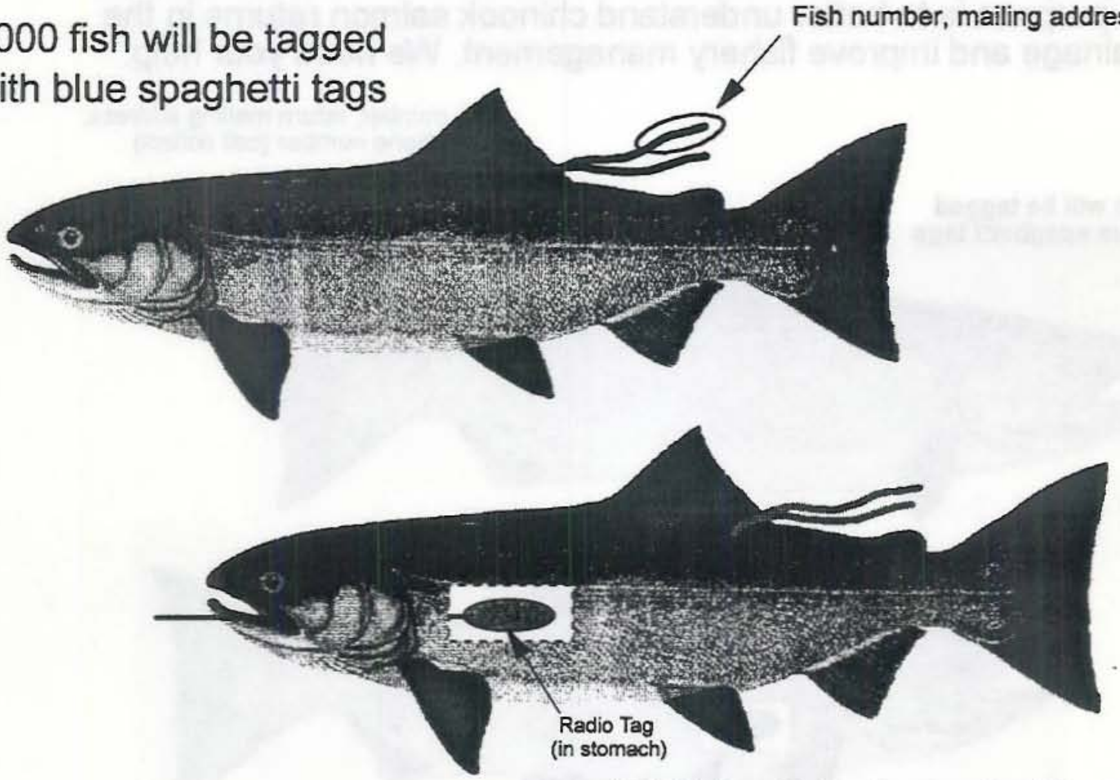
Note: Tag recovery instructions on back.

Appendix D.1. Tag return poster, 2000.

# TAGGED CHINOOK SALMON

**A tagging study is being conducted on Yukon River chinook salmon. The purpose is to better understand chinook returns in the drainage and improve management. We need your help.**

1000 fish will be tagged
with blue spaghetti tags




100 fish will be tagged with radio
tags and yellow spaghetti tags

## Please return tags with the following information:

- Date and time (morning or afternoon) caught
- Where caught
- Condition of the fish

## For more information contact:



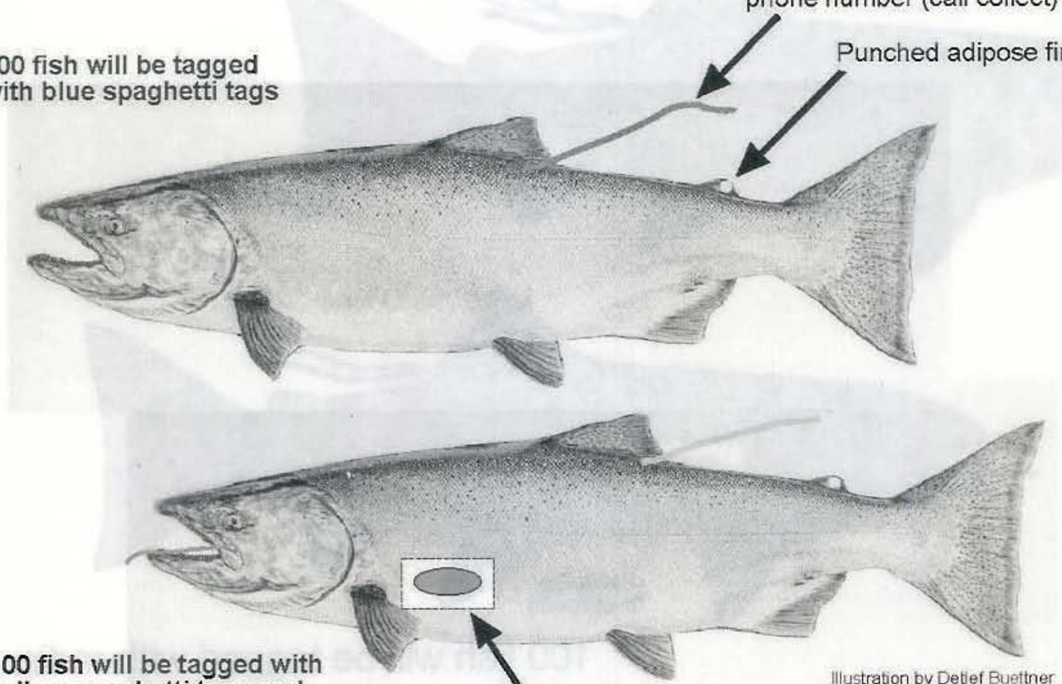
| | | | |
|---|---|---|---|
| Russ Holder | John Eiler | Monty Millard | Pat Milligan |
| ADF&G, Commercial Fish Division | National Marine Fisheries Service | USFWS, Fishery Resource Office | Department of Fisheries and Oceans |
| 1300 College Road | 11305 Glacier Highway | 101 12th Avenue, Box 20 | 200 Range Road |
| Fairbanks, AK 99701 | Juneau, AK 99801 | Fairbanks, AK 99701 | Whitehorse, Y. T. Y1A 2T9 Canada |
| Phone: (907) 459-7288 | Phone: (907) 789-6033 | Phone: (907) 456-0272 | Phone: (867) 393-6720 |

Appendix D.2. Tag return poster, 2001.

# CHINOOK SALMON TAG LOTTERY

## Win one of five weekly $200 prizes or a $500 (US) grand prize. Return tags to enter.

A tagging study is being conducted on Yukon River chinook salmon. The purpose is to better understand chinook salmon returns in the drainage and improve fishery management. We need your help.




## Please return tags with the following information:

- Your name, address, phone #
- Date and time caught
- Location caught
- Gear used (drift gill net, fish wheel, etc)
- Sex (male or female)
- Adipose punch present

## For more information contact:


Bill Busher
ADF&G / Commercial Fish
1300 College Road
Fairbanks, AK 99701
Phone: (907) 459-7274

John Eiler
National Marine Fisheries Service
11305 Glacier Highway
Juneau, AK 99801
Phone: (907) 789-6033

Monty Millard
USFWS, Fishery Resource Office
101 12th Avenue, Box 20
Fairbanks, AK 99701
Phone: (907) 456-0272

Pat Milligan
Dept. of Fisheries and Oceans
200 Range Road
Whitehorse, YT Y1A 2T9 Canada
Phone: (867) 393-6720

Appendix E.1. Letter sent post-season to fishers and agencies that recovered tags, 2000.

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

*DIVISION OF COMMERCIAL FISHERIES*

***TONY KNOWLES, GOVERNOR***

*1300 COLLEGE ROAD*
*FAIRBANKS, ALASKA 99701-1599*
*PHONE: (907) 459-7288*
*FAX: (907) 452-1668*

December 5, 2000

P.O. Box
Fairbanks, AK .99707

Dear

We greatly appreciate your cooperation in returning your Yukon River chinook salmon information this past summer. Your participation in this study contributed to our understanding of chinook salmon migration. This was the first season of a multi-year cooperative radio telemetry program conducted by the Alaska Department of Fish and Game and National Marine Fisheries Service. Drift gillnets were used on the lower Yukon River at two sites, near Marshall and Russian Mission, to capture 760 chinook salmon during June and July. Of these fish, 675 were marked with spaghetti tags and 91 also had radio transmitters inserted into their stomachs. There were 179 tags returned from subsistence fisheries and escapement projects.

The following table shows information on the tag(s) you returned: (If any of the recovery information is incorrect, please let us know.)

| Tag# (type) | Age | Tag Site | Date Tagged | Date Recovered | Days Traveled | Miles Traveled | Miles/ Day | Recapture Site |
|---|---|---|---|---|---|---|---|---|
| 000710 (spaghetti) | 6 | Russian | 6/27/00 | 8/8/00 | 42 | 754 | 18 | Chena 14 miles upstream of Chena Dam |
| 001058 (radio) | 5 | Russian | 6/25/00 | 8/9/00 | 45 | 748 | 17 | Chena 8 miles upstream of Chena Dam |

We recently finalized our reward drawing and congratulations go to the following lottery winners:

- $500 Grand Prize - Paul and Natalia Changsak, Russian Mission
- $200 Week 1 Prize - Harry Turner, Holy Cross
- $200 Week 2 Prize - Ron Kruger, Anvik
- $200 Week 3 Prize - Francis Captain, Jr., Ruby
- $200 Week 4 Prize - Ron Earhart, Stevens Village
- $200 Week 5 Prize - Sebastian Jones, Dawson City

Thank you for your participation this past summer and we look forward to continuing this salmon investigation with your help. If you have any questions, please give one of us a call.

Sincerely,

Russ Holder
AK. Dept. of Fish and Game
Fishery Biologist
Telephone: (907)459-7288

John Eiler
National Marine Fisheries Service
Fishery Research Biologist
Telephone:1-800-789-6005

Appendix E.2. Letter sent post-season to fishers and agencies that recovered tags, 2001.


STATE OF ALASKA

**DEPARTMENT OF FISH AND GAME**

*DIVISION OF COMMERCIAL FISHERIES*

*TONY KNOWLES, GOVERNOR*

*333 RASPBERRY ROAD*
*ANCHORAGE, ALASKA 99518*
*PHONE: (907) 267-2804*
*FAX: (907) 267-2442*


December 20. 2001

Yukon River Fisherman

Dear Yukon River Fisherman:

We greatly appreciate your cooperation in returning your Yukon River chinook salmon information this past summer. Your participation in this study contributed to our understanding of chinook salmon migration. This was the second season of a multi-year cooperative radio telemetry program conducted by the Alaska Department of Fish and Game and the National Marine Fisheries Service. Drift gillnets were used on the lower Yukon River at two sites, near Marshall and Russian Mission, to capture 2,313 chinook salmon during June and July. Of these fish, 2,011 were marked with spaghetti tags and 117 also had radio transmitters inserted into their stomachs. There were 327 tags returned from subsistence fisheries and escapement projects.

We recently finalized our reward drawing and congratulations go to the following lottery winners:

- $500 Grand Prize - Glenn Simon Sr., Stevens Village
- $200 Week 1 Prize - Ivan Demientieff, Holy Cross
- $200 Week 2 Prize - Eddie Hildebrand, Nulato
- $200 Week 3 Prize - Herb Desacia, Galena
- $200 Week 4 Prize - Dan Winfrey, Fairbanks
- $200 Week 5 Prize - Peggy Kormendy, Dawson City

Thank you for your participation this past summer and we look forward to continuing this salmon investigation with your help. If you have any questions, please give one of us a call.

Sincerely,

Ted Spencer
AK. Dept. of Fish and Game
Fishery Biologist
Telephone: (907)267-2804

John Eiler
National Marine Fisheries Service
Fishery Research Biologist
Telephone:1-800-789-6005

Appendix F.1. Daily catch and tagging summaries, Russian Mission and Marshall sites, 2000.

| | Russian Mission | | | | | | | | | Marshall | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Chinook salmon | | | | | | | | | Chinook salmon | | | | | | | | |
| | | Tagged | | Not tagged | | | | | | | Tagged | | Not tagged | | | | | |
| Date | Caught | Non-radio tagged | Radio tagged | Recap-tured | Mor-talities | Released alive | Chum salmon | Other fish | Hours fished | Caught | Non-radio tagged | Radio tagged | Recap-tured | Mor-talities | Released alive | Chum salmon | Other fish | Hours fished |
| 7-Jun | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1.5 | | | | | | | | | [a] |
| 8-Jun | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3.3 | | | | | | | | | [a] |
| 9-Jun | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 3.8 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 1 | 2.2 |
| 10-Jun | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 4.2 | 5 | 4 | 0 | 0 | 1 | 0 | 7 | 1 | 2.2 |
| 11-Jun | 5 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 2.6 | 8 | 8 | 0 | 0 | 0 | 0 | 5 | 2 | 2.8 |
| 12-Jun | 8 | 5 | 2 | 0 | 1 | 0 | 7 | 0 | 2.9 | 4 | 4 | 0 | 0 | 0 | 0 | 7 | 1 | 2.3 |
| 13-Jun | 5 | 3 | 0 | 0 | 2 | 0 | 14 | 0 | 3.4 | 11 | 10 | 0 | 0 | 1 | 0 | 5 | 0 | 2.3 |
| 14-Jun | 5 | 3 | 2 | 0 | 0 | 0 | 8 | 0 | 3.3 | 9 | 9 | 0 | 0 | 0 | 0 | 6 | 0 | 2.8 |
| 15-Jun | 9 | 4 | 3 | 0 | 2 | 0 | 7 | 0 | 2.5 | | | | | | | | | [a] |
| 16-Jun | 7 | 2 | 3 | 0 | 2 | 0 | 2 | 1 | 3.1 | 3 | 3 | 0 | 0 | 0 | 0 | 5 | 0 | 3.8 |
| 17-Jun | 2 | 2 | 0 | 0 | 0 | 0 | 6 | 0 | 3.5 | 9 | 7 | 0 | 0 | 1 | 1 | 1 | 0 | 3.4 |
| 18-Jun | | | | | | | | | [a] | 7 | 6 | 0 | 0 | 0 | 1 | 1 | 0 | 3.7 |
| 19-Jun | 6 | 4 | 2 | 0 | 0 | 0 | 9 | 0 | 3.3 | 9 | 8 | 0 | 0 | 0 | 1 | 7 | 1 | 3.2 |
| 20-Jun | 15 | 5 | 7 | 1 | 2 | 0 | 2 | 0 | 2.6 | 12 | 10 | 0 | 0 | 0 | 2 | 1 | 0 | 3.3 |
| 21-Jun | 10 | 8 | 1 | 0 | 1 | 0 | 6 | 0 | 3.2 | 25 | 23 | 0 | 0 | 0 | 2 | 4 | 0 | 2.8 |
| 22-Jun | | | | | | | | | [a] | 54 | 47 | 4 | 0 | 2 | 1 | 35 | 0 | 4.5[b] |
| 23-Jun | | | | | | | | | [a] | 53 | 39 | 5 | 2 | 4 | 3 | 40 | 1 | 3.9[b] |
| 24-Jun | 19 | 10 | 6 | 1 | 1 | 1 | 28 | 0 | 2.2 | 19 | 17 | i | 0 | 1 | 0 | 23 | 0 | 2.0 |
| 25-Jun | 11 | 5 | 3 | 0 | 3 | 0 | 16 | 0 | 3.2 | 20 | 16 | 2 | 0 | 0 | 2 | 9 | 0 | 2.4 |
| 26-Jun | 34 | 18 | 12 | 1 | 3 | 0 | 22 | 1 | 5.6[b] | | | | | | | | | [a] |
| 27-Jun | 39 | 26 | 11 | 0 | 0 | 2 | 27 | 0 | 5.7[b] | | | | | | | | | [a] |
| 28-Jun | 23 | 16 | 5 | 1 | 1 | 0 | 16 | 0 | 3.0 | 9 | 6 | 2 | 0 | 0 | 1 | 7 | 0 | 2.0 |
| 29-Jun | 8 | 4 | 3 | 0 | 0 | 1 | 9 | 1 | 3.3 | 18 | 14 | 2 | 0 | 0 | 2 | 27 | 0 | 2.0 |
| 30-Jun | 13 | 8 | 3 | 0 | 0 | 2 | 11 | 1 | 3.4 | 20 | 13 | 3 | 1 | 0 | 3 | 23 | 1 | 2.3 |
| 1-Jul | 13 | 13 | 0 | 0 | 0 | 0 | 19 | 0 | 3.5 | 22 | 19 | 3 | 0 | 0 | 0 | 40 | 0 | 1.8 |
| 2-Jul | 4 | 4 | 0 | 0 | 0 | 0 | 18 | 0 | 1.4 | 36 | 27 | 3 | 1 | 0 | 5 | 34 | 1 | 2.1 |
| 3-Jul | 19 | 17 | 0 | 1 | 0 | 1 | 35 | 1 | 3.0 | 22 | 17 | 2 | 1 | 0 | 2 | 21 | 1 | 2.2 |
| 4-Jul | | | | | | | | | [a] | | | | | | | | | [a] |
| 5-Jul | 11 | 9 | 0 | 0 | 0 | 2 | 29 | 1 | 3.8 | 7 | 6 | 0 | 0 | 0 | 1 | 18 | 3 | 3.4 |
| 6-Jul | 12 | 10 | 0 | 0 | 1 | 1 | 14 | 1 | 3.6 | 7 | 7 | 0 | 0 | 0 | 0 | 11 | 0 | 2.8 |
| 7-Jul | 4 | 3 | 0 | 0 | 1 | 0 | 19 | 4 | 3.1 | 5 | 4 | 0 | 0 | 0 | 1 | 22 | 1 | 3.7 |
| 8-Jul | 9 | 9 | 0 | 0 | 0 | 0 | 18 | 0 | 3.6 | 10 | 8 | 0 | 1 | 1 | 0 | 13 | 0 | 3.2 |
| 9-Jul | 9 | 8 | 0 | 1 | 0 | 0 | 26 | 2 | 3.8 | 5 | 5 | 0 | 0 | 0 | 0 | 25 | 1 | 2.8 |
| 10-Jul | 9 | 9 | 0 | 0 | 0 | 0 | 35 | 1 | 3.4 | 4 | 4 | 0 | 0 | 0 | 0 | 4 | 8 | 3.3 |
| 11-Jul | 7 | 6 | 0 | 0 | 1 | 0 | 17 | 1 | 3.7 | 6 | 5 | 0 | 0 | 0 | 1 | 6 | 1 | 4.5 |
| 12-Jul | 7 | 5 | 0 | 0 | 2 | 0 | 9 | 0 | 3.0 | 3 | 3 | 0 | 0 | 0 | 0 | 12 | 0 | 4.3 |
| 13-Jul | 3 | 3 | 0 | 0 | 0 | 0 | 21 | 3 | 3.4 | 6 | 6 | 0 | 0 | 0 | 0 | 10 | 0 | 3.9 |
| Site total | 329 | 226 | 64[c] | 6 | 23 | 10 | 450 | 23 | 97.2 | 431 | 358 | 27 | 6 | 11 | 29 | 429 | 24 | 83.2 |
| Project total | 760 | 584 | 91 | 12 | 34 | 39 | 879 | 47 | 180.4 | | | | | | | | | |

Total chinook salmon tagged: 675

[a] Did not fish at this site.

[b] Two fishing crews fished at this site.

[c] Includes 11 experimental radio tags which were not monitored beyond the tagging site.

## Appendix F.2. Daily catch and tagging summaries, Russian Mission and Marshall sites, 2001.

| | Russian Mission | | | | | | | | | Marshall | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Chinook salmon | | | | | | | | | Chinook salmon | | | | | | | | |
| | | Tagged | | Not tagged | | | | | | | Tagged | | Not tagged | | | | | |
| Date | Caught | Non-radio tagged | Radio tagged | Recap-tured | Mor-talities | Released alive | Chum salmon | Other fish | Hours fished | Caught | Non-radio tagged | Radio tagged | Recap-tured | Mort-alities | Released alive | Chum salmon | Other fish | Hours fished |
| 6-Jun | Did not fish | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.3 |
| 7-Jun | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 6.1 |
| 8-Jun | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3.9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7.8 |
| 9-Jun | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 3.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6.2 |
| 10-Jun | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3.9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7.2 |
| 11-Jun | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 4 | 3.2 | 5 | 4 | 0 | 0 | 1 | 0 | 0 | 8 | 7.4 |
| 12-Jun | 6 | 5 | 0 | 0 | 0 | 1 | 0 | 2 | 2.6 | 21 | 21 | 0 | 0 | 0 | 0 | 0 | 1 | 7.0 |
| 13-Jun | 7 | 4 | 0 | 0 | 0 | 3 | 0 | 0 | 2.7 | 10 | 10 | 0 | 0 | 0 | 0 | 0 | 2 | 7.1 |
| 14-Jun | 12 | 11 | 0 | 0 | 0 | 1 | 0 | 1 | 3.6 | 8 | 8 | 0 | 0 | 0 | 0 | 1 | 1 | 5.5 |
| 15-Jun | 20 | 18 | 0 | 1 | 0 | 1 | 0 | 0 | 2.8 | 14 | 12 | 0 | 0 | 1 | 1 | 0 | 1 | 6.2 |
| 16-Jun | 13 | 11 | 0 | 1 | 0 | 1 | 0 | 3 | 3.2 | 56 | 52 | 0 | 1 | 3 | 0 | 0 | 0 | 3.7 |
| 17-Jun | 17 | 15 | 0 | 0 | 1 | 1 | 0 | 0 | 2.5[a] | 50 | 47 | 0 | 0 | 3 | 0 | 2 | 1 | 3.6 |
| 18-Jun | 24 | 17 | 6 | 0 | 1 | 0 | 0 | 0 | 2.0 | 60 | 55 | 0 | 1 | 4 | 0 | 8 | 0 | 3.1 |
| 19-Jun | 21 | 7 | 14 | 0 | 0 | 0 | 1 | 0 | 1.8 | 58 | 57 | 0 | 1 | 0 | 0 | 20 | 0 | 3.6 |
| 20-Jun | 71 | 28 | 23 | 1 | 0 | 19 | 6 | 0 | 3.8[b] | 48 | 45 | 0 | 2 | 0 | 1 | 12 | 0 | 3.3 |
| 21-Jun | 62 | 40 | 19 | 0 | 3 | 0 | 12 | 0 | 3.6[b] | 35 | 34 | 0 | 1 | 0 | 0 | 17 | 0 | 3.7 |
| 22-Jun | 63 | 46 | 13 | 0 | 0 | 4 | 15 | 0 | 3.1[b] | 36 | 35 | 0 | 0 | 0 | 1 | 18 | 0 | 4.2 |
| 23-Jun | 68 | 49 | 14 | 1 | 0 | 4 | 56 | 0 | 3.4[b] | 29 | 26 | 0 | 0 | 0 | 3 | 18 | 0 | 5.7 |
| 24-Jun | 53 | 23 | 26 | 4 | 0 | 0 | 49 | 0 | 3.6[b] | 41 | 34 | 0 | 4 | 1 | 2 | 25 | 0 | 4.0 |
| 25-Jun | 28 | 26 | 0 | 0 | 0 | 2 | 34 | 0 | 1.9 | 56 | 45 | 0 | 1 | 1 | 9 | 17 | 1 | 3.9 |
| 26-Jun | 36 | 33 | 0 | 0 | 0 | 3 | 9 | 0 | 1.4 | 67 | 59 | 0 | 0 | 2 | 6 | 22 | 0 | 3.7 |
| 27-Jun | 28 | 25 | 0 | 2 | 0 | 1 | 1 | 0 | 3.1 | 116 | 78 | 0 | 2 | 1 | 35 | 23 | 0 | 2.4 |
| 28-Jun | 40 | 38 | 0 | 0 | 1 | 1 | 5 | 1 | 1.8 | 79 | 62 | 0 | 2 | 2 | 13 | 35 | 0 | 3.7 |
| 29-Jun | 45 | 41 | 0 | 0 | 1 | 3 | 5 | 0 | 1.8 | 90 | 66 | 0 | 0 | 5 | 19 | 28 | 1 | 3.0 |
| 30-Jun | 34 | 29 | 0 | 0 | 0 | 5 | 9 | 0 | 2.6 | 85 | 66 | 0 | 1 | 1 | 17 | 61 | 1 | 3.4 |
| 1-Jul | 32 | 28 | 0 | 0 | 1 | 3 | 15 | 0 | 2.2 | 59 | 51 | 0 | 0 | 1 | 7 | 38 | 0 | 3.1 |
| 2-Jul | 36 | 35 | 0[c] | 0 | 0 | 1 | 9 | 0 | 1.9 | 62 | 51 | 0 | 3 | 0 | 8 | 52 | 0 | 3.4 |
| 3-Jul | 32 | 25 | 0 | 0 | 0 | 7 | 5 | 0 | 1.7 | 32 | 30 | 0[c] | 1 | 0 | 1 | 43 | 2 | 3.2 |
| 4-Jul | Did not fish | | | | | | | | | Did not fish | | | | | | | | |
| 5-Jul | 29 | 23 | 0 | 0 | 1 | 5 | 21 | 0 | 1.5 | 25 | 22 | 2 | 0 | 0 | 1 | 16 | 1 | 4.9 |
| 6-Jul | 33 | 27 | 0 | 0 | 0 | 6 | 13 | 0 | 1.9 | 22 | 21 | 0 | 0 | 0 | 1 | 4 | 1 | 5.7 |
| 7-Jul | 29 | 24 | 0 | 2 | 0 | 3 | 14 | 0 | 1.8 | 26 | 25 | 0 | 0 | 0 | 1 | 19 | 0 | 6.0 |
| 8-Jul | 38 | 29 | 0 | 0 | 0 | 9 | 15 | 0 | 1.2 | 26 | 24 | 0 | 2 | 0 | 0 | 11 | 1 | 6.5 |
| 9-Jul | 38 | 30 | 0 | 3 | 0 | 5 | 9 | 0 | 2.0 | 16 | 15 | 0 | 1 | 0 | 0 | 22 | 1 | 6.4 |
| 10-Jul | 24 | 23 | 0 | 0 | 0 | 1 | 23 | 0 | 2.4 | 20 | 19 | 0 | 1 | 0 | 0 | 24 | 2 | 5.4 |
| 11-Jul | 15 | 12 | 0 | 1 | 1 | 1 | 19 | 0 | 2.6 | 10 | 9 | 0 | 0 | 1 | 0 | 12 | 0 | 4.6 |
| 12-Jul | 18 | 16 | 0 | 0 | 0 | 2 | 9 | 0 | 2.8 | 16 | 16 | 0 | 0 | 0 | 0 | 10 | 0 | 5.5 |
| 13-Jul | 13 | 11 | 0 | 0 | 1 | 1 | 25 | 0 | 2.3 | 6 | 6 | 0 | 0 | 0 | 0 | 5 | 0 | 3.4 |
| 14-Jul | 13 | 12 | 0 | 0 | 0 | 1 | 26 | 0 | 2.7[a] | 4 | 4 | 0 | 0 | 0 | 0 | 2 | 0 | 2.6 |
| 15-Jul | 11 | 10 | 0 | 0 | 0 | 1 | 8 | 0 | 2.4 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2.6 |
| 16-Jul | Did not fish | | | | | | | | | 3 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 2.9 |
| 17-Jul | 1 | 1 | 0 | 0 | 0 | 0 | 12 | 2 | 3.3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3.7 |
| 18-Jul | 4 | 4 | 0 | 0 | 0 | 0 | 10 | 4 | 2.9 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 2.3 |
| 19-Jul | 1 | 1 | 0 | 0 | 0 | 0 | 10 | 4 | 2.9 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2.9 |
| 20-Jul | 2 | 2 | 0 | 0 | 0 | 0 | 17 | 12 | 2.5 | Did not fish | | | | | | | | |
| Site total | 1,019 | 780 | 115 | 17 | 11 | 96 | 462 | 48 | 109.1 | 1,294 | 1,114 | 2 | 25 | 27 | 126 | 569 | 28 | 193.8 |
| Project total | 2,313 | 1,894 | 117 | 42 | 38 | 222 | 1,031 | 76 | 302.9 | | | | | | | | | |

Total chinook salmon tagged: 2,011

[a] Data not available. Hours fished estimated from previous and following two days.

[b] Two crews fished at the Russian Mission site 20 June to 24 June.

[c] Ran out of blue tags. Began using white tags beginning with the evening shift of fishing on 3 July.